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Engineering Applications of Information Technologies

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The field “Information Technologies” has been expanding its topic and boundary in the past decades in order to reflect the complex requirements of the information society. Consequently, many academic studies have tried to address the complex information science and technology issues in wider perspectives.

Thus, the RISTI - Revista Iberica de Sistemas e Tecnologias de Informacao presents actual papers on main topics of journal specialization to address and focus new innovative and emerging areas in information technologies. The Vol. 2015, No. 18A has 30 selected extended articles presented at the panel discussion on Information Management and Computer Engineering held in July 2015 in Guangzhou China, which aims to more deep insights about the development of “Engineering Applications of Information Technologies”.

This edition is the continuation of our publishing activities, all the included contents were anonymously reviewed by distinguished experts to maintain academic excellence and integrity. We assure our readers that RISTI - Revista Iberica de Sistemas e Tecnologias de Informacao will serve as a key exchange platform for publications in information science & technology field. The authors and readers can count on the journal.

Índice / Index

EDITORIAL

Engineering Applications of Information Technologiesvii
Wen Huabin, Ting Cheng

ARTIGOS / ARTICLES

Design and Research of Intelligent Vocabulary Learning System Based
on Multimedia Technology..... 1
Hongmei Wang, Xiaoxia Liu

The Application of Computer Multimedia Platform in Music Education..... 13
Li Jian

Research on the Influence of Different Freezing Temperatures and
Different Water Contents to the Soil's Coefficient of Thaw Settlement and
Compression Characteristic Under the Condition of Freeze-Thaw Cycles23
Cui Honghuan, Liu Jiankun, Zhang Liquan

Research on Banking Customer Management System of Commercial
Banks Based on Data Mining Technology 36
ri xu, huijun xue

Study on the Complementary Model of Traditional Sports Teaching with
Multimedia Technology..... 48
Zhou Jing

The Study and Application of Computer 3D Graphics Technology to
Management Informationization in the Whole Process of Construction Costs..... 58
Feng Jianmei

A Study on the Modern Art Design Based on Computer Technology 70
Li Boyi

On the Research of Force into Computer Database Intrusion Detection Technology80
Mao Yi

Research of Travel Information Service System Development Based on GIS
Applications 90
Xiaobai Li

An Investigation of Constructing Electric Power Telecommunication
Information System Based on Computer Information Technology 101
Si Wenjian

Research on the Applications of Computer VR (Virtual Reality) Technology
in Physical Training..... 113
Huang Qi, Zou Xiaowei, Ma Tiemin, Li Hui

Realization of Automobile Marketing Management System Based on .NET Structure.....	125
<i>Wang Yanmei</i>	
Study on Multi-media Physical Education Based on Computer Platform.....	141
<i>Shi Zhenrui</i>	
Comprehensive Energy Saving Model Design of New Residential Construction in Rural Areas of Hebei Province	152
<i>Renyi Xi</i>	
Network Reliability Study Based on Analytic Hierarchy Process (AHP)	165
<i>Wenli Hu, Min Yi</i>	
Computer Assisted Instruction to Improve the Tennis Forehand Strokes Test Research.....	176
<i>Li Yi-feng, Wang Hai-Ming</i>	
Research on Computer Precise-Optimization Algorithm of Predictive Data Based on Electric Load Measurement.....	186
<i>Guo Chong, Ji Jianwei, Wang Zheng</i>	
Credit Risk Assessment Model of SMEs Based on Multi-Level Fuzzy Comprehensive Evaluation- A Leather Factory in Wenzhou as an Example	197
<i>Jin Xinyuan</i>	
Analysis and Research on Seismic Damage Index of Reinforced Concrete Intake Tower Structure	211
<i>Zheng Xiaodong, Liu Yunhe</i>	
Research on face recognition algorithm for data encryption virus	223
<i>Zhu Yulan, Hong Xin</i>	
Application of UAV in the Field Management of Construction Project.....	235
<i>Li Hongxia, Fan Qi</i>	
Application of Bayesian Multi Kernel Learning Algorithm Based on Support Vector Machine in Feedback Mechanism.....	244
<i>Dang Shuwen</i>	
Agricultural Economic Input-output Analysis Research Based on Computer Information Technology.....	257
<i>Xin Yu</i>	
The Research on the Building of University Physical Education Model Based on the Construction of Computer Multi-agent	270
<i>PengyiYan</i>	
Financial Risk Early Warning Model of Public Hospital Liability Management Based on Data Mining.....	282
<i>Shanshan Wan2g</i>	

Graphic Design Research Based on Computer Graphics and Image Software.....	293
<i>Hui Huang, Junjian Liu, Jianchun Shao</i>	
Research on Temperature Control System of Baby Bath Center Based on Fuzzy PID Control.....	306
<i>Song Limin, Li Ping</i>	
Based on Mobile Agent Data Acquisition of Mobile Campus Network Construction.....	316
<i>Gao Jing</i>	
Research on the Methods of Identifying Defect Positions of Anchor System Based on Instantaneous Frequency	333
<i>Zhang Lei, Li Qiang, Mao Xian-biao, Chen Zhan-qing, Lu Ai-hong</i>	
A Study on New Detection and Control Approaches of Distortion Currents for Active Power Filters	343
<i>Dong Yanfei, Ge Guangjun</i>	

Design and Research of Intelligent Vocabulary Learning System Based on Multimedia Technology

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Abstract: With the development of globalization, fluency in English is becoming increasingly important. Using advanced computer technology and extensive network resources to assist in learning English vocabulary can make it easy and fun to memorize English vocabulary. Conforming to learning requirements of English courses for primary and secondary students, change the traditional single rote learning method, systematically realize English learning through multiple channels like vocabulary book learning, English associative learning, video labels, and pronunciation scoring module; personal space, learning archive and incentive mechanism modules are employed to record users' learning information, which can directly give users feedback about their learning outcomes. This paper builds the video learning and pronunciation scoring modules by adopting Java EE lightweight platform which is composed of Struts, Spring and Hibernate, and uses the player designed by Flex technology to increase human-computer interaction flexibility. In terms of the pronunciation module, apply a hidden Markov model to guarantee the accuracy of English pronunciation scoring.

Keywords: Intelligent learning; computer-assisted learning; JavaEE; Flex; hidden Markov chains.

1. Introduction

With the development of economic globalization, English has played an increasingly important role in our life and work. Memorizing sufficient numbers of English words is a necessary condition to learn English well. In recent years, people discover that relying on the traditional way which is rote learning to memorize words would be low efficient and easy to forget, while using associative memory can significantly speed up memorization and improve people's memory. Most associative memory books on the market use root plus transliteration or directly scramble the letters. Though these are conducive to memorizing words, it is very limited. In recent years, a large number of words memorization APPs in application stores use the forgetting curve to design the learning content and learning time of users, but they do not use an effective way to assist in memorization. Therefore, using flexible multimedia and human-machine interactive digital English learning has become the current trend of learning English. Using computer to assist in learning English vocabulary is the cornerstone of digital English

learning; computer-assisted English learning is inseparable from computer technology; associative memory is realized through artificial intelligence, voice recognition, and network technology in technology computer, so the development of computer technology has also contributed to developing memorizing English words. Linguist Sapir said that: “the word is one of the smallest, completely satisfying bits of isolated meaning into which the sentence resolves itself.” British linguist D. A. Wilkins said: “Without grammar, one cannot express many things, without words, one cannot express anything”. Hence, the importance of memorizing vocabulary to English learning is self-evident. The system has adopted Java EE lightweight platform composed of Struts, Spring, and Hibernate, which minimizes the coupling degree of various modules so as to optimize and expand the future system. (Kikot, T., Fernandes, S., & Costa, G., 2015) The system not only has the traditional word learning module but also added video and audio learning modules. Flex technology is utilized to study the video; this technique can add captions to the video, and allow more flexible human-machine interaction during the video watching process. In audio learning, a HMM statistical model for audio comparison algorithm is adopted, so that users can obtain an accurate English pronunciation when viewing the spelling. The system uses the above investigation results and divides all words in the word module into three levels, namely: strange, familiar, and mastered. Learners can make a choice as per their mastery of words. If they choose the “mastered” option, this word will no longer appear in the word book to avoid a waste of time. Unfamiliar words appear most frequently in the word book, so that learners memorize them critically; familiar words are mixed to increase learners’ mastery level. The video and pronunciation learning modules in this system divides the video according to different difficulty levels; learners can select videos to learn according to their learning level. As for the pronunciation learning module, students can not only hear the standard pronunciation of words; more importantly, the system can score based on learners’ pronunciation and find out pronunciation shortcomings by contrast. Learning is combined with teaching, thus increasing the learning efficiency.

2. Implementation Framework and Core Technology for Associative Intelligent Vocabulary Memory Systems

The lightweight JavaEE framework uses the traditional JSP as the presentation layer technology, and a series of open-source frameworks as the MVC layer, business logic layer and data persistence layer solutions. In addition, these open-source frameworks are organically combined so that it has a high degree of scalability and maintainability and can effectively shorten the development time and deployment time.

The system adopts Java EE lightweight platform composed of Struts, Spring and Hibernate. Below the three open-source frameworks are introduced.

Struts is an MVC framework implemented in JSP Model2 architecture. It is divided into three parts, which are Model, View and Controller (Stickler, U., & Shi, L., 2016). The main design concept is decoupling performance logic and business logic through the controller in order to improve the maintainability of the system.

Spring is an open-source framework that resolves the complexity of enterprise application development. It is a lightweight inversion of control and aspect-oriented

container (Godwin-Jones, R., 2015). The so-called inversion of control means that the container's initiatives passing of dependencies to a dependent object when it is initialized without making a request, but not the dependent object looks for dependencies from the container; the so-called aspect-oriented means that it allows business logic and system-level services to separate applications for cohesion exploitation (Wach, A., 2015).

Hibernate is an open-source object-relational mapping framework (Bishnoi, S. W., 2016). It is a lightweight object encapsulation of JDBC so that Java programmers can freely use object-oriented programming thinking to operate the database. Hibernate can be used in any occasions using JDBC, either in the Java client program or in the Web applications (Watanabe, Y., & Nakao, M. T., 2016), thereby realizing the persistence of task completion.

Figure 1 shows the view from the top after integrating there open-source frameworks of Struts, Spring and Hibernate.

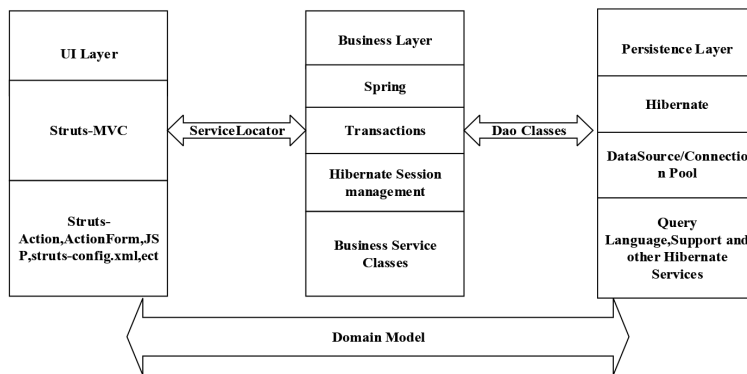


Figure 1 – SSH Framework Integration View

Flex is a highly effective RIA development product set based on the standard programming model. It was initially released by Macromedia in 2004 and registered trademarks of Adobe (García-Villanova, R. J., Berruezo, J. A., & Maurologoitia, J. I., 2015). The most notable feature of Flex is that it is based on the global popular online animation platform--Macromedia Flash.

A complete Flex application consists of MXML code and ActionScript code. MXML is based on XML standards and used for configuring and designing the Flex application interface and writing the presentation layer data model. ActionScript is based on ECMAScript and was originally used to design Flash animation; its syntax resembles JavaScript syntax. These two development languages based on the W3C standard constitute a Flex application, and the relationship resembles HTML and JavaScript. The system uses Flex 3 for development.

A HMM model is a statistical model of a double-layered random process (Bhardwaj, M., & Rana, A., 2015); one-layer random process describes the statistical characteristics of stationary segments in non-stationary signals, and the other layer describes how to shift from short-time stationary segments to the short-time stationary segments, which is the

dynamic characteristic of short-term stationary statistical characteristics. The random process of the former can be observed while the latter is hidden in the observed sequence and cannot be observed. This double-layered random process feature of HMM can be used to simulate human voice production.

A HMM model has two hidden Markov chains: one is jumping profile hidden Markov chains, as shown in Figure 2. This model has a small number of calculation and is suitable for modeling with the speech signal.

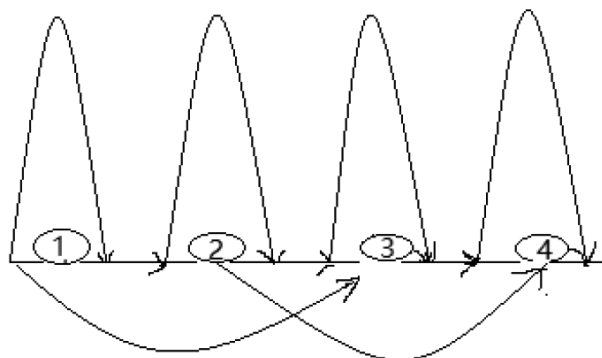


Figure 2 – With Hidden Markov Chain

The other is simpler and more common hidden Markov chain, which does not have state crossing, and it is known as non-crossing left-to-right hidden Markov chains, as shown in Figure 3.

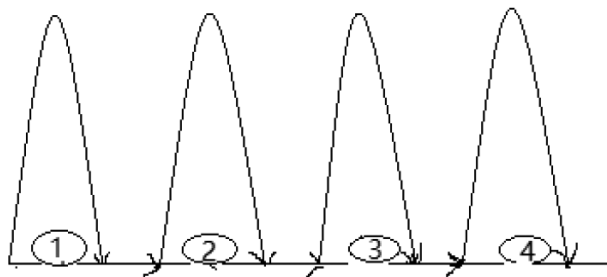


Figure 3 – No Hidden Markov Chain

A HMM model involves three basic questions: (1) model assessment: determine which algorithm to use according to the given sequence of observations; here the forward algorithm is mostly used; (2) best path problem, here the Viterbi algorithm is usually used; (3) model training.

3. Design of Video Label Learning Module

The video label learning module is one of the most important parts of the whole system. This module should not only enable administrators to add, delete and change (edit) a

video, but also allow system users' query operation, video playing and external caption, label display and quiz popping of the entire video playing process.

3.1. Video Editing Sub-Module

This sub-module is divided into Chinese-English caption editing, label information editing, quiz editing, among others. This module stores video captions to be edited in XML files; video_editinfo, the video editing information table, (structured in Table 1) only needs to store the disk location and file name of XML files, so that the computer facilitates speedy access to captions, reduces the consumption of physical space, and facilitates the use of the player (Benites, A. B., & Palenzuela, M. E. V., 2015).

Each element of <captions> corresponds to a Chinese-English caption; each <captions> element contains <time>, <ecaption>, <ccaption> which respectively record video playing time, English captions, and Chinese captions. When administrators edit video, after saving the Chinese-English captions, the video captions will be saved in XML files.

Field Name	Date Type	Instruction
<i>Video_id</i>	INTERGRE	Video number,primary key,since the increase in the system is theonly logo, video corresponds to the video_id field in table video_basicinfo
<i>Cdedc</i>	VARCHAR	Video instruction in Chinese
<i>Edesc</i>	VARCHAR	Video instruction in English
<i>Last_editor</i>	VARCHAR	Video editors at last
<i>Last_edittime</i>	DATETIME	Video editing time finally
<i>State</i>	INTERGER	Video state, whether issued. "0": To be released; "1": Published
<i>Deployer</i>	VARCHAR	Video publishers
<i>Deploytime</i>	DATETIME	Video release time
<i>Level</i>	INTERGER	Video learning level
<i>Degree</i>	INTERGER	Video difficulty,from 1 to 5 video,in turn,increase the difficulty
<i>Keys</i>	VARCHAR	Video,keyword search video when used
<i>Video_label</i>	VARCHAR	Logo for video information of the XML file
<i>Video_caption</i>	VARCHAR	Logo to store video synchronous XML files in both Chinese and English subtitles
<i>qa</i>	VARCAHR	Identifies the store video synchronous q &a XML files

Table 1 – Video Editing Information Table Video_Editinfo

The module uses XML files to store label information; its role and advantages are equivalent to the storage way of Chinese-English captions. The label file format uses <label> element; a <labels> element corresponds to label information; each <labels> element contains five sub-elements: time, horizontal ordinate, longitudinal coordinates, label symbol, and label information. The label file is automatically generated when an administrator edits video and saves it. The file name is in the format of video number+lab.xml.

Q&A edit is adopted with the same XML files to store information; after the storage form and edit storage, the system will automatically generate a file of which the name is in the form of video number+qa.xml.

3.2. Design and Implementation of Video Playing Sub-Module Function

In this system, videos are in FLV format. This format has a small volume, so there is a fast loading speed. Users do not require high-quality network during the learning process (Sylvestre, D., Jean-Marc, B., Jean-Claude, M., Jacques, W., Phillipe, C., Alain, S., & Santiago, L. R., 2016), and thus can have a nice viewing experience. Players need to be completed by using a VideoDisplay component in Flex technology. As it does not have input or output function, the component needs assistance of other components when playing videos (Duncan, S., 2015). Using an MXML to label `<mx: Button>` and create two button components--playOrPause_btn and startOrStop_btn to control video playing; by `<mx:HSlider>`, create two horizontal slider components--content_hsl and sound_hsl to control the playing progress and volume.

To use this the player in the browser, source files should be first compiled into .swf files by Flex, and then displayed in the form of plug-ins. After videos in .swf files receive the video number, and the number is treated, by converting the player we can find the source property of display_vd, and then play the video.

External caption means while playing the video, captions will pop out of the video being played. The caption is generated by administrators in the video editing process. The system needs to pass to VideoStudy.swf the current video caption file in form of video number+cap.xml; VideoStudy.swf should receive the file in form of Application. application.parameters.ccapxml and then load the XML caption file.

The system here uses `<mx: TextArea>` label to create two text fields--ecaption and ccaption--to display the external Chinese-English captions, respectively, and then the system uses playheadUpdate property in the VideoDisplay component to synchronize captions, thereby playing the video while at the same time plugging in English-Chinese captions.

Q&A pop-up means that issues related to the playing content occur outside the player and its achievement resembles external caption functionality. Its implementation steps are:

1. Create a Q&A pop-up window.
2. Pass the current video Q&A file to VideoStudy.swf, and VideoStudy.swf will automatically load the XML Q&A file.
3. Use playheadUpdates property in VideoDisplay component to monitor video playing, and respond in a timely manner.
4. Compare the current video playing progress with the time in `<time>` label in Q&A files in a cycle continuously. If the same, the Q&A information will pop up; if user answers match the `<answer>` content, obtain the corresponding scores; if there are any doubts, view the exploration in `<explanation>`.

Click Edit to enter the video editing interface; administrators can add Q&A and labels according to their needs at the right position of the video player. The video editing interface is shown in Figure 4.

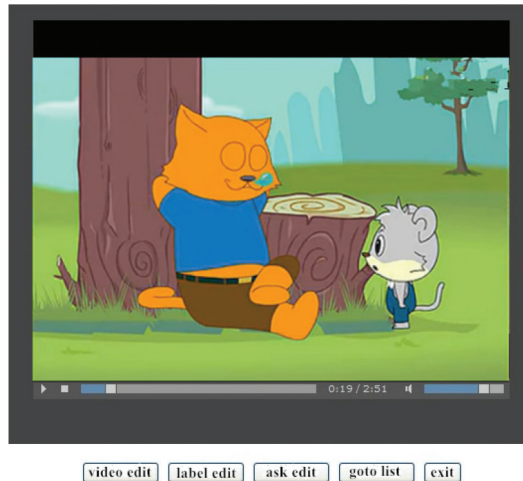


Figure 4 – Video Editing Interface

After users log in to the learning system and choose the course for learning, there will be a column of videos on the video learning interface to choose from, and users can also find videos by searching video's name and other attributes. After entering the video learning interface, the system will pop up to questions or labels during playing as per administrator setting. The display interface is shown in Figure 5:



Figure 5 – Video Learning Interface

4. Design and Implementation of Pronunciation Scoring Module

Because of the real-time feature of voice signals, this module adopts the Java Web Start framework. Since the module requires timely collecting and processing voices of users, there are relatively high requirements for interactivity. In the same way, the memory module overhead should be also as small as possible; when receiving users'

pronunciation, the system should try to avoid ambient noise; the interface should be simple, practical and easy to master. The module can analyze users' pronunciation and accurately and timely feedback the deficiencies. The module materials should keep up with users' learning needs and enable users to learn in combination with their own materials.

In the pronunciation scoring module, voice reception and audio playing will inevitably involve Java audio processing. This process uses a top-level API which can store and play MIDI data (Andrew, J., 2015). After the module inputs the voice, the recognizer sub-module identifies the voice and distinguish the accuracy of pronunciation by comparing the similarity degree between the voice received and that in the system. After the recognizer gets the processing result, the scoring sub-module will score the pronunciation conforming to the result.

After users log in the system and select “pronunciation practice” to enter the pronunciation scoring interface, they can select the learning content according to their needs. For example, select words in the learning list; if this is a strange word, users can choose to listen to the standard pronunciation before doing pronunciation practice. The interface is displayed in Figure 6:

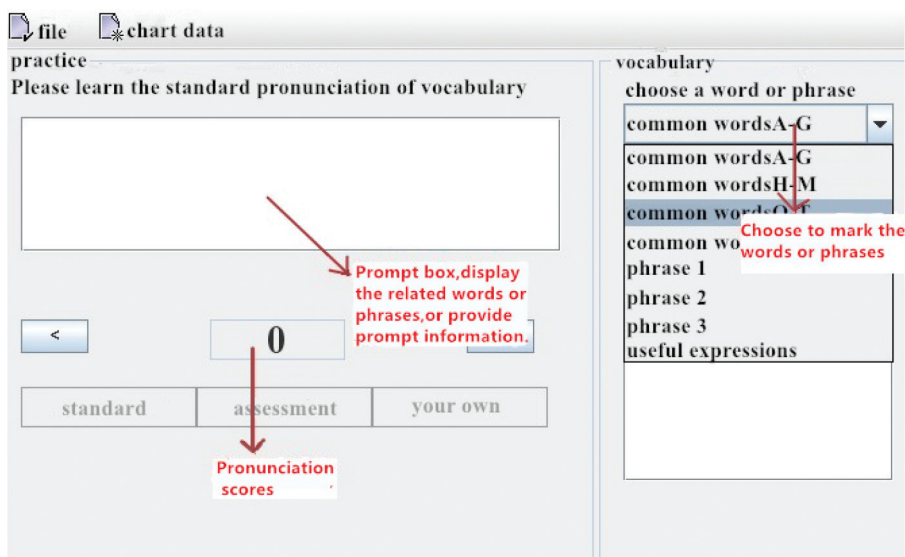


Figure 6 – Pronunciation Practice Interface

5. Analysis of Learning Effect by the System

In traditional English teaching, the relationship between teachers and students is one to many, while all students have different learning abilities and learning progress, which means that it is almost impossible for all students to plan their own learning activities that suit their schedule. Moreover, traditional teaching has a drawback that teachers' teaching model and students' learning model are single and rigid. Students would feel

boring and have a poor memory and efficiency when learning English words. The system makes an investigation of the academic performance, methods to memorize words, and learning effectiveness of 90 students in a high school; the investigation results are shown in Table 2 and Fig. 7:

Scores range	Number of people	Proportion
< 60	4	4.4%
60–80	18	20.1%
80–100	50	54.9%
100–120	13	15.4%
120–150	5	5.2%

Table 2 – The Initial Test Scores

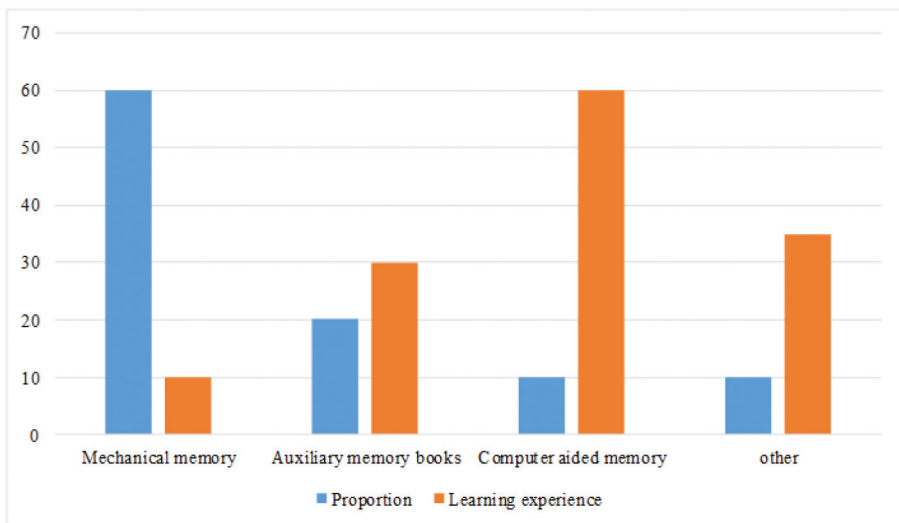


Figure 7 – Students' English Learning Methods and Effective Statistics

As can be seen from the table, the English average score of 90 students is no less than 90, and this score is very undesirable. This bar chart demonstrates that most of the 90 students currently use a traditional memorizing mode and their learning methods are relatively simple. In order to test the learning effect of this intelligent word learning system, we require these students to log into the system, select an appropriate learning level, uses the word book provided by the system for memorization, watch videos, and correct English pronunciations when learning English words every day. After using the system for half a semester, the English test scores are exhibited in the table below. For the sake of visually showing changes in two English test scores, we make a statistical graph 2 which shows a markedly improvement in the average score of these 90 participants, who also claim to have fantastic learning experience. As can be seen from this survey, only

relying on the traditional mechanical memory method and English vocabulary books is very unfavorable for students to learn English.

With the permission of their teachers, we create accounts for these 90 students and recommend that they log in to this system when memorizing English words every day; each student may choose their own learning content as per their different interest and conditions. Three months after using the system, they have an English exam and the exam results of these 90 participants are displayed in Table 3:

Scores range	Number of people	Proportion
< 60	1	1.1%
60—80	9	10.0%
80—100	52	57.8%
100—120	17	18.9%
120—150	11	12.2%

Table 3 – The Final Exam Results

To visually display the differences between two test scores, we make a bar graph 8 as follows:

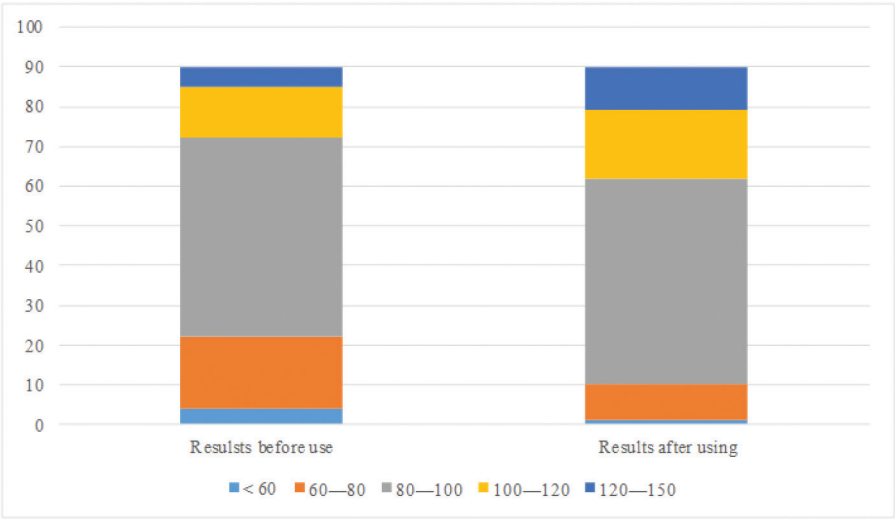


Figure 8 – Two Different Examination Results

As can be seen from Figure 8, after using the system, the average score of these 90 students has been vastly improved, and the number of failures is one; the top and medium students scoring between 100 and 150 have increased from 20% to 30%. Through this intuitive learning proficiency test, it can be found that this system is significantly helpful in improving students' English learning, improving their English performance in a short time, and strengthening students' confidence and motivation to learn English.

6. Conclusion

In this paper, the interactive intelligent learning system not only has a common word memory module, but also allows users to watch videos to memorize words and practice their pronunciations through the pronunciation scoring module. This system uses B/S architecture and Java EE lightweight platform which is composed of Struts, Spring and Hibernate, which can improve the development efficiency, reduce development workload to some extent, and facilitate management and maintenance. Flex technology is employed in the video player, which can not only play FLV files smoothly but also add the video label and Q&A human-machine interactivity. The pronunciation module uses a hidden Markov chain model, which can speed up cup reactions, correctly and accurately process pronunciations received by the system, and make timely and comprehensive feedback. Because the learning method uses a computer-aided learning mode, it has a large number of Internet educational resources, so that users can be exposed to more options and choose high-quality learning materials. The system instills pleasure into learning, uses artificial intelligence and human-computer interactive system, and adopts scientific and effective English teaching ideas, so it has great significance for users to learn English.

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The Application of Computer Multimedia Platform in Music Education

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Abstract: The application of computer technology and network technology in education is becoming more and more deeply. It provides abundant resources for education and has opened up a broad prospect. Based on the idea and technology of multimedia platform, we use this form of Blog Education to establish a platform for students and teachers to learn. It can promote students' autonomous learning, expand their knowledge and enhance their communication, so as to stimulate students' learning interest and improve their learning effect. Through the analysis of the characteristics of blog music education, it is to explore the practice and function of blog in the process of music education in Colleges and universities. The results show that the Blog assistant education of the multimedia platform has a certain reference and guiding significance for the contemporary education.

Keywords: Multimedia platform; music education; blog assisted instruction.

1. Introduction

Since entering in twenty-first Century, with the rapid development of science and technology and information industry, the emergence of multimedia technology and network technology has changed the mode of operation and development of various fields, and also changed the way of life and education. With the rapid development of information technology, the education is facing new requirements and education reform is a necessity, which makes the education information came into being (Dunbar-Hall P., Rowley J., Brooks W., et al., 2015). Information education is a modern information technology in various fields of education and teaching activities. It is effective to develop and utilize the information resources. It can quickly and accurately convey information. The teaching of multimedia platform has greatly improved the quality of education, teaching efficiency and innovation ability. Nowadays, it is an important task to explore new teaching methods and cultivate new talents. The meaning and range of multimedia technology is very wide, it is difficult to give a precise definition. We use Lippincott and ftobinson in 1990 to give the definition: multimedia computer technology is the use of computer integrated processing of a variety of media information - text, graphics, images and sounds, etc (Cano M D., Sanchez-Iborra R., 2015). Processing objects can include text, graphics, images, video, animation and sound and other information, but also to deal with a variety of information and the integration of them together (Crawford S., Fitzpatrick P., 2015). Multimedia

technology has the characteristics of integration, real-time, interactive and high quality. Blog appeared in 1998 in the United States, began in 2000. At present, the application of Blog in foreign teaching is more and more, and the electronic archives, collaborative learning and knowledge management are applied in the distance education, classroom teaching and learning. (Carvalho, A. A., Araújo, I., & Fonseca, A., 2015) Many education experts have become Blogger, and have established their own education network log, and other people on the network to share their education experience, many education experts have made a lot of research results in the field of Blog application in education, such as the Blog and the education: experience life course sharing, Fang Xingdong teacher's "based on the blog of knowledge operation mechanism research," Dr. Zhuang Xiuli "Blog- a network environment research learning good helper", etc. Under the guidance of education experts, more and more teachers have begun to try to study the teaching of Blog, Such as Lin Wenjuan's "" based on the blog to explore and practice the teaching of College English writing, Zhao Shuhua's "Blog in the computer based teaching research," Bu Weihong's "Blog based high school composition teaching exploration," Zhang Zhengguo's "Blog" in the class of collective construction, management and moral education in the application research, Lin Wenjuan teachers, "based on the blog of College English writing teaching exploration and practice", etc. The emergence of the blog and its unique advantages will soon be applied to various fields. Because of its simple operation, it has the advanced educational concepts, such as research study, independent learning, cooperative learning, constructivism and so on (Ou F C., 2015). It has the advantages of information resources navigation, collaborative inquiry, exchange evaluation and scientific management platform. In the course of subject teaching, the teacher can pass the information to the students, and the students can pass the information to his partner and teacher, and create a more relaxed, open and simple learning environment for students. It is an effective teaching and learning tool for students and teachers and students (Huang C F., Nien W P., Yeh Y S., 2015).

2. Analysis of Multimedia Platform in Music Education

2.1. Basic Principles of Multimedia Platform

The word "multimedia" is the earliest translation by English word "multimedia" comes, it is a composite word in English, is composed of multiple and media two words compounded core vocabulary is media, translation for the media, there are two main explanations: one is that like a disk, disk, tape, semiconductor memory of this type of information stored objects, sometimes also translated the word as a medium; another is that all kinds of information such as some carrier, numbers, text, sound, graphics and images, generally translated into media (Gonidis F., Paraskakis I., Simons A J H., 2015). The media in this paper is generally understood as second meanings. The narrow sense is the expression form and the transmission way of many kinds of information carriers, and the generalized multimedia can be divided into the following five categories (Hong S R., Shin I Y., 2015):

Feel media: such as language, music, a variety of images, animation, text, etc. Through a direct role in people's sense organs, and the people of this kind of media can produce a direct feeling of a media, we call this media feel media (Blom D., Rowley J., Bennett D., et al., 2014).

Media language: such as language encoding, telegraph code, bar code, etc., in order to transmit the sense of the media, and the human study out of the media. This media can

not only store the sense of the media, but also to achieve the transfer of the feeling of the media.

Display media: such as display, input, output facilities, the mouse and other used in communication to make the communication between the media and the feeling of the media to produce a conversion between the media.

Storage media: such as paper, tape, disk, CD and other media used to store some media.

Transmission media: such as telephone lines, cables, optical fiber, etc. for the transmission of certain media (Jot J M., 1999).

Multimedia is a large number of audio-visual information contains a new teaching media, with the traditional “chalk + blackboard” teaching mode, it allows students to teachers’ teaching appeal greatly enhanced, at the same time, but also greatly expand the teaching of the depth and breadth of the corpse if even feel the teaching contents in the audiovisual process really Yu Miao honestly, these are used to describe the empty language teachers simply can not match. At present, this technology has been developed and utilized in many countries in the world. The digital of the growing popularity of music classroom: portable music system, interactive music learning software is more and more popular in our daily life (Tsou W., Wang W., Tzeng Y., 2006).

2.2. Analysis of the Characteristics of Multimedia Platform Education – Blog

Blog can be seen as a quick update of the personal web site, but it also can meet the needs of group communication. Although Blog is a log, but in fact, it set of articles, notes, communication, news, personal home page as a whole. Compared with the traditional Forum (BBS), Blog is more able to display the personality, more targeted; compared with the ordinary web site, Blog has a more powerful interactive features. Through practice, the characteristics of Blog are applied to education:

Read and write combined: the information released in the Blog are arranged in chronological order. Blog posted content is recorded every day learning experience, insights and see the essence, realize the combination of reading and writing practice, students questioned, deliberative, discernment and practice experience exchange learning cycle (ZHOU P., QIN X., 2005).

Resource sharing features: Blog release information, publishing experience, and the exchange of their learning and social communication, students can publish their own knowledge in their own Blog and the content of the network to allow others to reference, comment, but also through the Blog of others to learn, research, and to join the discussion, so that students in the community to share and exchange in a further understanding (Juang Wang T., 2010).

Implication of advanced education concept: Blog contains the advanced educational concepts, such as constructivism, process learning, independent learning and reflective learning. In the information society, students can build and improve the knowledge based on the existing knowledge, and can make the key decisions, which is the successful learning. Constructivism holds that students are actively involved in the construction of the meaning of the active learning, which requires students to continue to self reflection.

A learning method of constructivism is to encourage students to express their own understanding and thinking process in a timely manner.

2.3. Analysis of the Educational Function of Multimedia Platform -- Blog

Blog has many advantages over other network tools, many domestic and foreign experts have done some relevant research, and gradually be applied to education in the education. "Blog" is the United Nations "International Education Commission in twenty-first Century" proposed "education of the four pillars (learn to learn, learn to do things, learn to live and learn to live and learn to survive)".

The practice shows that the function of Blog application in education can be summarized as the following six aspects:

(a) providing a rich context for learning

At present many of the teaching website, the connection is just to provide some reference data, and Blog can provide more evaluation, learning background information more widely.

(b) cognitive approach

Blog has a constructivist learning theory. Constructivism holds that knowledge is not gained by teachers, but students in a certain situation, namely, social and cultural background, with the help of other people (including teachers and learning partners), the use of necessary learning materials, through the construction of meaning.

(c) communication platform between teachers and students

The emergence of Blog provides the convenience for the study of network education. It can provide teachers with a reflective record, the teachers write down their own teaching experience and experience, so as to summarize, evaluate and improve. Students can be involved in this, put forward their own proposals and programs, and teachers to communicate. In order to facilitate the development of collective learning activities, timely exchange of ideas, to strengthen the relationship between teachers and students, to promote their close cooperation and common progress.

(d) communication and collaboration platform

Blog can effectively encourage students to participate, not only to read and comment on the teacher or other students of the Blog log, but more importantly, you can set up your own Blog log, set your own issues, and share their ideas with others. Teachers can learn from the network collaborative learning platform in time to understand the learning situation of students, and teachers can make collaborative learning activities by uploading data and other ways to make a more in-depth and detailed.

(e) information literacy training

Information literacy is mainly divided into three aspects: first, the use of information technology tools for the specific purpose of information retrieval; two is to master the use of various basic information technology tools; three is to comply with the rules of the exchange of information and moral norms.

(f) information evaluation platform

The important feature of Blog is that the information can be converted into useful knowledge, but the knowledge of Blog has no value, the value is in any place, there is no supplementary information. This approach can be trained to discriminate between the students.

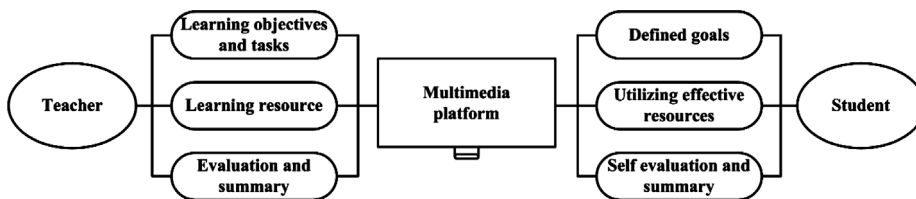


Figure 1 – Blog Aided Teaching Mode

For teachers, the process of writing the Blog is mainly to sort out the process of their own knowledge system, the process of the Blog is the process of the learners to construct their own knowledge system. Of course, in the course of the Blog, the teacher is also constantly re constructing their own knowledge system, while the students are constantly finishing their knowledge. Blog is a new kind of network application tool, it increases the information of the personalized and the distribution, and takes full advantage of the traditional community function and link technology, so that more people with common interests to increase the interaction and knowledge sharing. Therefore, it can be fully applied to all aspects of work, study and life. According to the characteristics of Blog, it will provide a new way to improve the students' cognitive level from the perspective of knowledge management to improve the students' cognitive level.

2.4.Features of Blog Platform Education

Blog has the characteristics of simple, fast and low cost. Blog is like a simplified personal home page. Without any site production technology, the application to establish a simple and quick, easy to express views or comments.

Blog has the characteristics of openness, privatization and interactivity. Blog is a personal private space, can be a subject of public comment, and keep on their own web pages. Blog will also automatically record the brief information about the comments of your article. Blog is a more flexible, more personalized knowledge sharing and exchange form.

Blog has shared features. Blog's advantage is to continue to search and extract information, continuous learning and thinking. The essence of Blog is to select and record the content that they think is valuable from the perspective of individual, and to provide help to others. Blog spirit is the core of a spirit of altruism.

Blog has the characteristics of a subscription, easy management, and real-time transmission. Blog is an easy to manage personal electronic publishing system. You are free to record, publish, and update, and to classify the articles. If you are interested in the "music education" on Blog, you can subscribe to the Blog related tools. When new messages are created, they will be delivered to you at any time.

Blog has the characteristics of full communication and cooperation between the participants. Blog's easy to use and instant release provides a convenient condition for

the establishment of a network interactive community. People have their own Blog, it can be easily used to expand the discussion of some topics.

3. Analysis of Experimental Results

In the application of the blog auxiliary public music curriculum education experiment, the experimental class and control class music basic knowledge of the first test, in the experimental implementation of a semester, the experimental class and control class after the music. As shown in Table 2, table 1, through the comparative analysis of the results of the two test, we try to find out how to help students learn the public music curriculum in Colleges and universities through the application of blog assisted learning.

Since the number of the two different populations in this experiment is more than 30, it belongs to the large sample, so the Z test is used to analyze the results of the statistical analysis.

3.1. Test Data Statistics and Comparative Analysis

Before experiment	Class	Number	Average	Standard deviation	Quadrant	Statistical characterization
	Experimental class	$N_1=42$	$\bar{x}_{1a} = 36.07$	$S_{1a} = 11.177$	second quadrant	Average level is low, there is a high segmentation
	Control class	$N_2=38$	$\bar{x}_{2a} = 36.32$	$S_{2a} = 11.526$	second quadrant	Average level is low, there is a high segmentation

Table 1 – Test Data and Statistical Analysis of the Experimental Class and the Control Class

Before experiment
$$Z = \frac{36.07 - 36.32}{\sqrt{\frac{11.177^2}{42} + \frac{11.526^2}{38}}} = -0.070, |Z| < 1.96.$$
 The difference

between the two groups was not significant.

After experiment	Class	Number	Average	Standard deviation	Quadrant	Statistical characterization
	Experimental class	$N_1=42$	$\bar{x}_{1a} = 78.43$	$S_{1a} = 7.129$	Fourth quadrant	Average level is high, relatively concentrated, excellent
	Control class	$N_2=38$	$\bar{x}_{2a} = 66.74$	$S_{2a} = 11.135$	First quadrant	The average level is high, the separation is large, there is a low level.

Table 2 – Test Data and Statistical Analysis of the Experimental Class and the Control Class

From the above data can be seen, before the experiment, two classes of results are close, the knowledge of the two classes is very close, no significant difference; after the experiment, the results of the two classes are very significant, it is proved that the application of blog in music education is suitable for teaching, On the other hand, $S_{1a}=7.129 < S_{2a}=11.135$, from the experiment results also show that the balanced development of the auxiliary application of blog in university public music education curriculum in the form of more conducive to all students.

3.2 Comparative analysis of final examination results

At the same time, two classes were examined, and the final exam was the same test paper, the full score is 100, the passing score is 60, the excellent score is 85. On the experimental classes and control classes of two classes of the assessment results of processing, statistical data as shown in table 3. The average score, pass rate, excellent rate of the two classes were compared, and the data were processed by Exce12003 Microsoft. The results were analyzed by using column chart:

(1) Test data statistics

Class	Average	Pass the number	Pass rate	Excellent number	Excellent rate
Experimental class	81.3	41	97.62%	9	21.43%
Control class	72.5	33	86.84%	3	7.89%

Table 3 – Comparison Between the Test Results of the Experimental Class and the Control Board

(2) Statistical analysis

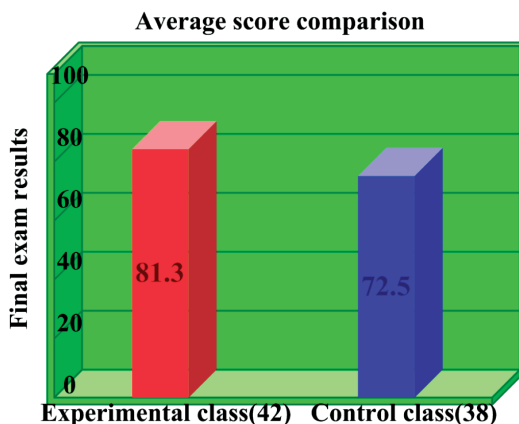


Figure 2 – The Average Score of the Experimental Class and the Control Class

According to the above results, you can see the application of the blog in public music courses in Colleges and universities, the end of the experimental class average score is higher than the control class of 8.8 points, passing rate of 10.78%, excellent rate of 13.54%. Therefore, the application of the blog in the ordinary university music course is satisfactory, and can promote the students to better grasp the knowledge of the course.

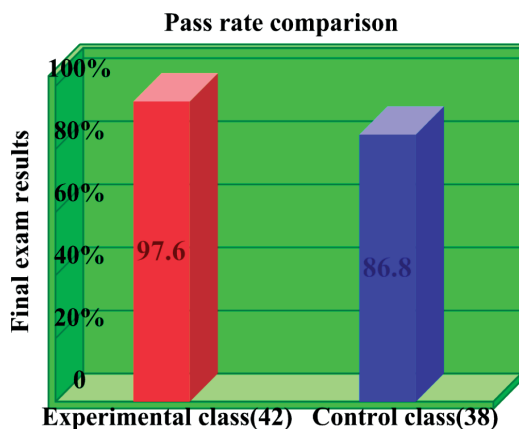


Figure 3 – The Passing Rate Between Experimental Class and Control Class

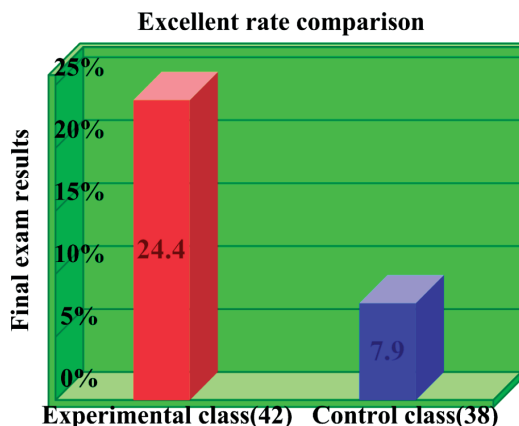


Figure 4 – The Excellent Rate Between Experimental Class and Control Class

4. Conclusion

Under the guidance of constructivism theory and collaborative learning theory, Blog teaching is combined with conventional classroom teaching. This paper discusses the influence of Blog on the design, application and knowledge of students, including aesthetic ability, independent learning ability, cooperation ability, innovation ability and so on. This paper puts forward the application mode of Blog application in music assisted teaching in Colleges and universities. It provides a useful model for the application of Blog in the teaching of its subject.

Through the analysis and comparison of the experimental class and the control class of the music education final examination, it is proved that under the same conditions, the effect of Blog assisted teaching is obvious. Using Blog to assist teaching not only expand the classroom knowledge, but also cultivate students' ability of self inquiry, aesthetic ability and innovation ability. It is a learning platform with information

resources navigation, collaborative inquiry, exchange evaluation, scientific management knowledge, and can create a more relaxed, more open, more simple learning environment.

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Research on the Influence of Different Freezing Temperatures and Different Water Contents to the Soil's Coefficient of Thaw Settlement and Compression Characteristic Under the Condition of Freeze-Thaw Cycles

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Abstract: Frost heaving, frost boiling and thaw settlement are the common diseases of roadbed in seasonal frost area. Studies on the mechanism and influence factors of those damages have great practical meaning to engineering construction. The stress-strain behavior of thawing silty clay were analyzed by thawing-compression tests. It was found that water content, cooling temperature and thawing temperature had significant influence on soil's behavior. Through the thawing-compression test, the relational curve(p-s curve) between pressure and unit deformation under all levels of loads is obtained with the increase of numbers of freeze-thaw cycles, modulus of compressibility loss of soil specimen is ever-increasing, which indicates that the damage ratio on the internal structure of soil material in unit volume is also increasing. Modulus of compressibility loss of soil material gradually inclines to be stable until six times of freeze-thaw. The disturbance of freeze-thaw cycle against soil body is caused by the expansion of pore from water to ice. And different models were deduced for describing the stress-strain curves at different water content and cooling temperature, which showed great disagreement with the soil at normal temperature.

Keywords: Thaw Settlement; Freeze-Thaw Cycles; Freezing Temperature; Water Content; Modulus of compressibility.

1. Introduction

There are many factors that result in the deformation of roadbed in permafrost areas, such as thawing of permafrost, construction quality, lateral erosion of water supply, uneven compaction of roadbed, and frost heave. In winter, due to the decrease of atmospheric temperature, in the process of heat exchange between earth surface and atmosphere, some sections constantly lose heat (Lai YM, Yang YG, Chang XX, 2010). The temperature of soil body reduces to the freezing point of water in soil. There is freeze and frost heave in the soil body (Li SQ, Gao LX, Chai SX, 2012), resulting in the

burst of road surface. Meanwhile, due to the uneven heat and water distribution in soil, the uneven frost heave, heave and tilt and other phenomena of destruction occur (Jing GQ, Feng K, Gao L, Wang J, 2012), resulting in great damage to road surface. In spring, the expanded sections thaw and sink, the frozen water cannot be timely released, the roadbed is damp and soft and its intensity declines (Kong L, Peng R, 2011). After pressed by vehicles, the frost heave sinks and the mud spurts. During roadbed design in frozen soil areas, the coefficient of thaw settlement and coefficient of melt compression are used to estimate the hot melt settlement and compression settlement (Mu YH, Ma W, Sun ZZ, Liu YZ, 2010). The two parameters are obtained through melt compression test in lab or the melt compression test of field-frozen soil (Bi GQ, Zhang X, Li GY, 2010).

Under the condition of one-dimensional compression, after thawing of frozen soil, the stable settlement calculation formula is as follows (Li Guowei, YangTao, 2005):

$$s = a_0 h + a_{tc} h \bar{\sigma}_z \quad (1)$$

In formula (1), h is the original height of soil body, $\bar{\sigma}$ is the additional stress on soil body, a_0 is the coefficient of thaw settlement and a_{tc} is the coefficient of melt compression.

$$a_0 = \frac{\Delta h_0}{h_0} \quad (2)$$

$$a_{tc} = \frac{s_{i+1} - s_i}{p_{i+1} - p_i} \quad (3)$$

modulus of compressibility is:

$$E_s = \frac{1 + e_0}{a_{tc}} \quad (4)$$

Formula (1) is the important relational expression used to calculate the thawing and settlement of frozen soil in Soviet Union and Russia, and it is widely applied in China. This paper focuses on the discussion of coefficient of thaw settlement (Belo, A., Castela, G., & Fernandes, S., 2013).

The reason for frost heave in soil body is that the water in soil body freezes and the volume increases (Wang L, Zhang S, Peng SB, 2012). However, when the soil body freezes, not all water freezes. There is part of unfrozen water in soil body. When the freezing temperature is lower, the unfrozen water content is smaller, the change in the volume of soil body is greater (Quan XJ, Li N, Li GY, 2004), and the coefficient of thaw settlement is large. Therefore, the temperature of frozen soil directly determines the compression degree of frozen soil. More importantly, the temperature of permafrost in the natural state determines its stable state and its sensitivity to external disturbance (Xu XZ, Sun X, Liu Qi, 2005). After the road construction disturbs the environment of permafrost, the average temperature of permafrost and the ice content determine the melt speed of frozen soil (Zhou FX, Lai YM, 2010), as well as the melt settlement and deformation of frozen-soil roadbed. Therefore, during the process of road construction

in cold region, the ground temperature of permafrost is one of the most important evaluation indicators.

In the process of thawing of frozen soil, there are two factors resulting in thaw settlement (Zhang Yanmei, Zhang Hongru, Zhang Xudong, 2005). Firstly, when the temperature of solid body rises, the volume reduction from ice to water results in melt settlement. Secondly, under the self-weight effect, the soil body sinks, resulting in compression deformation. In addition, in permafrost areas, the roadbed will experience many thaw-freeze cycles (Zhou J, Yang YX, Liu Y, Jia MC, 2009). In this process, the positions of soil particles change, from the dynamic unbalanced state to the dynamic balanced state. The coefficient of thaw settlement changes due to the influence of thaw-freeze cycle (Yan Shuwang, Cui Wei, 2005). Through measuring the coefficient of thaw settlement of remolded-soil test specimen with different water contents in different freezing temperatures in different freeze-thaw cycles, this paper tries to find the main factors affecting the coefficient of thaw settlement and its law, in order to provide reference for the road engineering survey.

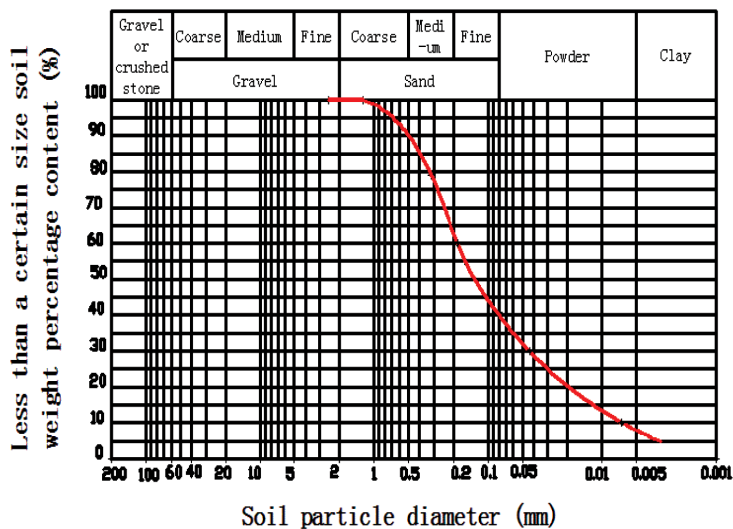


Figure.1- Size Grading Summation Curve of Soil

2. Materials And Methods

2.1. Thaw Settlement Test

The soil material used in this test is taken from Zhang-Cheng highway to Guyuan highway. According to “Soil Test Rules” (GB/T50123-1999), it is defined as the silty clay. Through photoelectric liquid-plastic limit joint tester, its liquid limit is 29%, plastic limit is 13% and optimum water content is 14.5%. Its size grading summation curve is shown in Figure 1.

Firstly, prepare soil samples with the water contents of 12%, 16%, 20%, 24% and 28% according to the requirements for soil samples and specimen preparation in “Soil Test Rules”. Mix the soil with water of designed content. After 24 hours, take a certain

amount of wet soil according to a certain dry density, and then make specimen through static force pressure. The specimen ring is made of organic glass materials, with the inner diameter of 79.8 mm, height of 40 mm and wall thickness of 5 mm. In order to ensure no deformation of organic glass when the specimen is pressed by the static force, two clamps are separately added to the up and down outside of specimen ring (Liang Bo, Zhang Gui-sheng, 2006). Put the molded specimen in the plastic film for seal up, and then put in the maintenance pool to make water content even. Specimen size: diameter is 79.8 mm; height is 40 mm. In order to observe the effects of freezing temperatures on the coefficient of thaw settlement, classify each kind of soil sample into 3 groups of specimens. First group is frozen at -5°C and thawed at room temperature. Second group is frozen at -10°C and thawed at room temperature. Third group is frozen at -15°C and thawed at room temperature. In each group, there should be 7 specimens for each water content. Respectively make the thaw settlement test (1 standby specimen) after 1,

3, 5 6, 9, 11, 13 freeze-thaw cycle(s). Observe the effects of water contents on thaw settlement. In a group, the number of specimens is 35. In this test, there are $3 \times 35 = 105$ specimens prepared.

The melt compression test is conducted in the low-temperature chamber, with the temperature controlled at -1°C . In the chamber, the equipment includes refrigeration equipment, fans, heat chambers and temperature controllers. Melt compressor is improved according to original conventional consolidometer as well as the requirements of permafrost thaw compression test in section 29 of "Soil Test Rules" (GB/T50123-1999). The components include lever-pressing device, heating plate, temperature probe, temperature controller and deformation dial indicator.

3 Results Analysis

3.1. Test Observation and Data Analysis

When a specimen is put in the incubator for freeze, its surface will be firstly frozen under the effect of cold air. The center water in the specimen moves towards the area with freezing peak surface. There is ice crystallization on the surface of the specimen. This is because between the surface of specimen and the unfrozen area in the center of specimen forms a temperature gradient. When the temperature drops below 0°C , the soil water freezes and the volume expands by 9%, thus destroying the binding strength between soil particles. When the temperature of specimen starts to rise, the specimen surface firstly starts to melt under the effect of surrounding air. Since the temperature of the center of specimen is always lower than that of surface in the process of thaw, the water on the surface moves towards the center. With the rise of specimen temperature, the ice in soil melts and the volume decreases from ice to water. Under the effect of self-weight, the soil body will be solidified, so its volume decreases.

1. Influence law of the thaw coefficient about water content

Test shows that the thaw settlement coefficient increases with the increase in water content. The frost heave of soil body is caused by the increased volume from water to ice. In normal temperature, the volume decreases from ice to water. Under the effect of self-weight, the soil body will be solidified. The more the water content is, the larger the thaw settlement coefficient is. In each temperature, the relation between thaw settlement coefficient and water content can be the following linear relation.

$$a_0 = A\omega + B \quad (5)$$

A and B are the fitting data obtained from the test

Freezing temperature	a_0	Correlation coefficient
T=-5°C	0.1283 ω -2.0005	R=0.943
T=-10°C	0.1523 ω -2.1681	R=0.962
T=-15°C	0.1889 ω -2.2015	R=0.913

Table 1 – Relation between Thaw Settlement Coefficient and Water Content

2. Influence law of freezing temperature on thaw settlement coefficient

Test results shows that in different freezing temperatures, the lower the freezing temperature is, the greater the thaw settlement coefficient is. This is because the lower the freezing temperature is, the smaller the unfrozen water content in soil is and the larger the volume of ice. The thaw settlement coefficient has a linear relation with the absolute value of freezing temperature. Considering the effects of two key factors—water content and freezing temperature and using matlab software for fitting, the fitting formula of silty clay used in this test is as follow:

$$a_0 = 0.1419\omega + 0.035|T| + 0.0436 \quad (6)$$

Wherein, the correlation coefficient $R = 0.833$. when the confidence coefficient is 0.95

$$F = 7.764 > F_{0.05}(4,20) = 2.87 \quad (7)$$

(7)indicating in this experimental system, the multiple linear regression model rejects non-significant assumption and the freezing temperature and water content have a significant influence on the thaw settlement coefficient.

3.2. Influence of Freeze-thaw Cycle on Thaw Settlement Coefficient

It is believed the freeze-thaw action will increase the thaw characteristics of soil. This is mainly because the freezing of water in soil increases the pore volume. When the pore ice melts, some enlarged pores cannot restore to their original states, so that the soil becomes loose and the binding strength between soil particles decreases. In this regard, whether several freeze-thaw cycles make the thaw settlement coefficient constantly increase or convergent at a certain stable phase after increase awaits research. Here, I make the thaw settlement test on the melt compressor with the freeze-thaw cycle of 1, 3, 6, 9, 11 and 13. Since the water content of 12% is close to the water content for starting thaw settlement of soil body, the thaw settlement coefficient is very small. It is not easy to analyze laws. Therefore, the analysis is based on the measured data when the water content is 16 %, 20 %, 24 % and 28%:

In the permafrost engineering investigation, according to relevant regulations, the settling volume is estimated based on the measured data after one freeze-thaw cycle of original soil during measuring the thaw settlement coefficient. Through test, it can be found that the influence of the freeze-thaw cycle on the thaw settlement coefficient should not be overlooked. The disturbance of freeze-thaw cycle against soil body is caused by the expansion of pore from water to ice. After melt, the pore cannot restore to its original size, thus changing the soil structure.

The most adverse condition of permafrost thaw settlement is in some cycle from the third freeze-thaw cycle to sixth freeze-thaw cycle. Therefore, the design according to the thaw settlement coefficient obtained from one freeze-thaw cycle is not safe, which will lay hidden risk for the future operation of roadbed foundation. Take the thaw settlement coefficient corresponding to one freeze-thaw cycle as the criterion. Compare the thaw settlement coefficients corresponding to other freeze-thaw cycles and set A/A_0 . Figure 4 and Figure 5 clearly show the influence law of freeze-thaw cycle on the coefficient of thaw settlement.

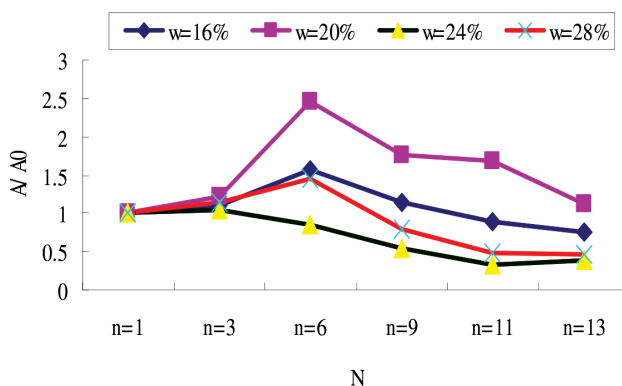


Figure 2 – Curve of Thaw Settlement Coefficient with the Cycle of Freeze-thaw at $T = -5\text{ }^{\circ}\text{C}$

According to above figures, this paper suggests that the thaw settlement coefficient used for design should be larger than that corresponding to one freeze-thaw cycle. If conditions permit, it is necessary to conduct 3 to 6 freeze-thaw cycles for the specimen in the constant temperature humidity chamber. After this, based on thaw settlement coefficient measured, the estimation of settling volume is more scientific and safer.

3.3. Analyze the Influence of Freeze-thaw Cycles on the Compressibility of Soil with Different Water Contents

Freeze-thaw cycles, thus altering the mechanical property of soil mass. Through the above thawing-compression test, the variation law of thaw-settlement coefficient is examined and concluded, and the relational curve ($T = -15^{\circ}\text{C}$, p - s curve) between pressure and unit deformation under all levels of loads is also obtained, when the soil specimen with different water contents is under different freeze-thawing cycles, as shown in Fig. 6-10. The p - s curve with the same water content under different freeze-thaw cycles reveals the variation tendency. Through several freeze-thaw cycles, the soil compressibility

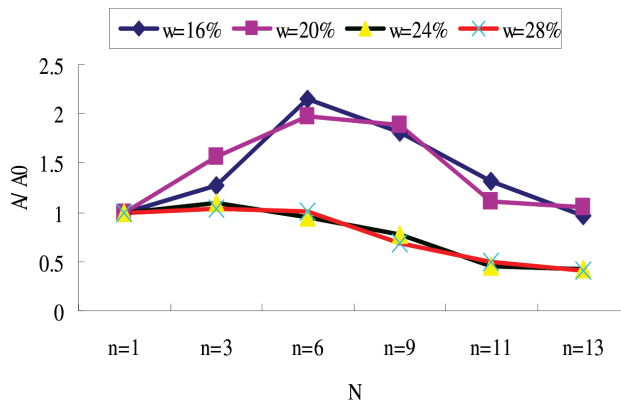
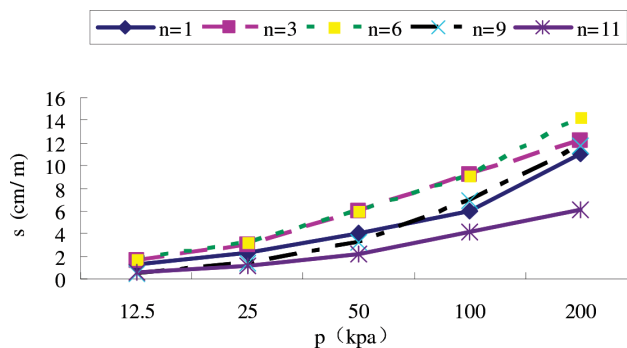


Figure 3 – Curve of Thaw Settlement Coefficient with the Cycle of Freeze-thaw at $T = -15^{\circ}\text{C}$

when $n=3$ or $n=6$ is significantly higher than the compressibility when $n=1$, “ n ” is the cycles of freeze-thaw.

Figure 4 – $w=12\%$

From the above test curves, the compressibility of soil initially increases and then decreases, with the increase number of freeze-thaw cycles. When $n=3$ or $n=6$, the disturbance is the strongest under freeze-thaw cycles, which draws the same conclusion with the above discussion on the thaw-settlement coefficient. When $n>6$, the compressibility of soil mass tends to initially decrease and then become dense. Therefore, it is dangerous to calculate the settlement using the thaw-settlement coefficient, if only one freeze-thawing cycle ($n=1$) is considered.



As shown in the curve, higher water content means stronger compressibility of soil mass. Regarding the variation tendency, when the pressure is the smallest (or $p=12.5\text{kPa} \sim 25\text{kPa}$), the curve inclines to be flat with lower slope, which indicates that soil void ratio has an insignificant decline as reflected in relatively low soil compressibility within this range of pressure. When $p=25\text{kPa} \sim 50\text{kPa}$, the slope increases, and the unit soil compression has bigger variation, thereby showing higher compressibility. When $p=50\text{kPa} \sim 100\text{kPa}$, the slope decreases, showing lower compressibility. When $p=100\text{kPa} \sim 200\text{kPa}$, the soil compression curve gradually inclines to be flat, which ultimately reaches a stable value.

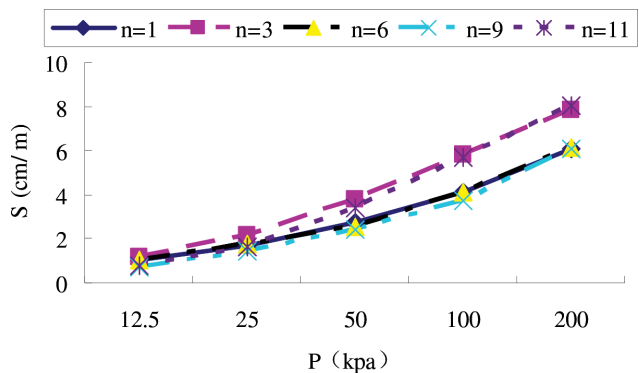


Figure 5 – w=16%

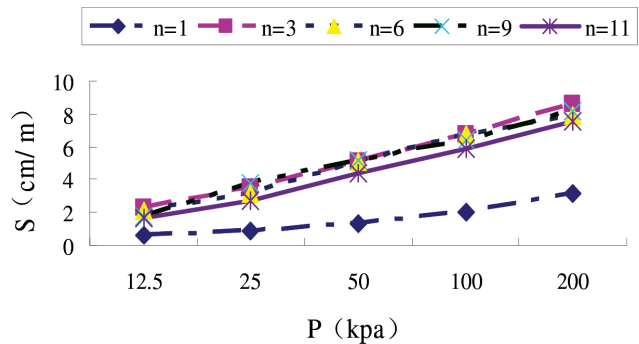


Figure 6 – w=20%

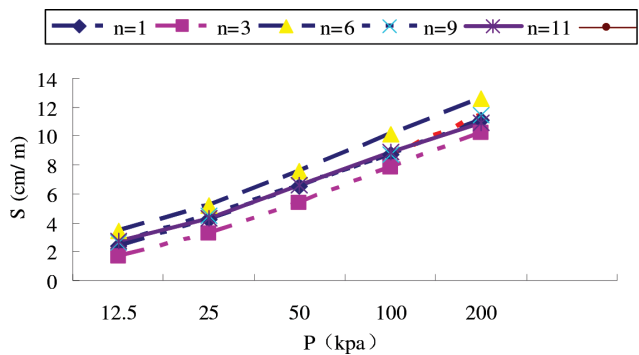


Figure 7 – w=24%

Soil compression variation law under the freeze-thaw cycles as shown in Fig.6-Fig.10 They satisfies the logarithmic relationship.

In view of water contents, the correlation among compression, freeze-thaw cycles and water content can be expressed as below:

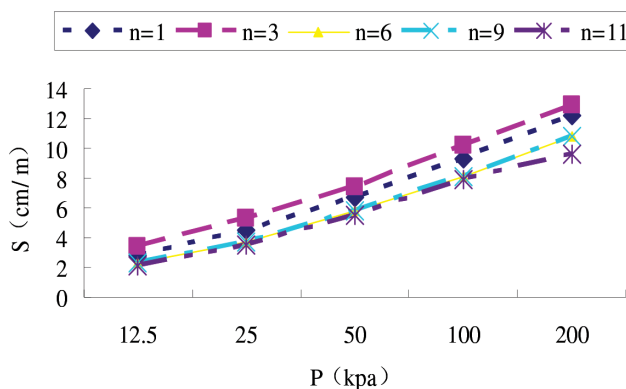


Figure 8 – w=28%

$$s = ae^{1+w} \ln p + b \quad (8)$$

Wherein, “s” is the unit amount of compression, “w” is the water content of soil specimen, and “p” is the unit pressure. “a” and “b” are functions correlated to the numbers of freezing-thaw cycles respectively, as drawn from the test conducted.

The correlation between “a”, “b” and numbers of freeze-thaw cycles can be expressed as below:

$$a = 0.0037n^4 - 0.0085n^3 + 0.674n^2 - 1.8421n + 4.061$$

$$b = -0.0142n^4 + 0.3565n^3 - 2.909n^2 + 8.725n - 13.215$$

From the above analysis, total deformation of thawing and settlement is influenced by soil property, water content, numbers of freeze-thaw cycles and other factors. Whether from the perspective of mathematics or engineering practices, thawing and settlement will reach a stable value with the increase of “n” after several cycles of freezing and thawing. Unit pressure and unit deformation satisfies the logarithmic variation relationship as shown in Equation (7).

3.4. Compressibility Modulus Loss Caused by Thawing and Freezing Cycles

Through p-s curve, Equation (4) can be applied to conclude the soil thawing compressibility modulus with different water contents varying with the numbers of freeze-thaw cycles, E_{s200} is analyzed here. Subgrade soil is prone to the damage caused by freeze-thaw cycles, and the mechanical property of soil material will be lowered with the increase of numbers of freeze-thaw cycles. Due to this reason, the damage degree on the soil is observed and examined by selecting the damping variation of modulus compressibility as shown in test results.

$$\Delta E_{si} = E_{i0} - E_n \quad (9)$$

Wherein, ΔE_{si} is the loss of modulus of compressibility, E_{i0} is the modulus of compressibility of unfrozen soil, and E_{in} is the modulus of compressibility of freeze-thaw soil after “n” cycles (“n” is the numbers of freezing and thawing).

According to the definition of modulus of compressibility loss, the comparative analysis aided Origin software is made on the modulus of compressibility loss of remolded soil material due to different damage factors (e.g.: numbers of freeze-thaw cycles, negative temperature of freezing and thawing, and soil water content, etc.), as shown in Fig below:

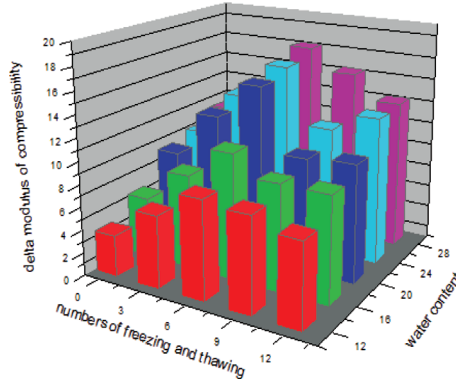


Figure 9 – Modulus of Compressibility Loss Varying with Water Content and Numbers of Freezing and Thawing ($T = -5^{\circ}\text{C}$)

With the increase of numbers of freeze-thaw cycles, modulus of compressibility loss of soil specimen is ever-increasing, which indicates that the damage ratio on the internal structure of soil material in unit volume is also increasing. Modulus of compressibility loss of soil material gradually inclines to be stable until six times of freeze- thaw.

Different water contents could influence the modulus of thawing compressibility loss, which can be expressed as its higher modulus loss when the initial water content of soil is higher, modulus of compressibility loss gradually increases with the increased numbers of freeze-thaw cycles, and modulus loss of soil specimen with lower water content under different numbers of freezing and thawing tends to be smaller than that of specimen with higher water content. Under the influence of different freezing negative temperatures, soil specimens with different water content have such a tendency that modulus of compressibility loss inclines to increase with the decrease of freezing negative temperature. Through fitting test data, modulus of compressibility loss can be expressed as follows:

$$E_s = E_{s0} - \Delta E_{si} = (L_1 w + L_2 |T| + \frac{w}{n|T|}) n^{\left(\frac{1}{1+e^T}\right)} \quad (10)$$

Wherein, “ L_1 ” and “ L_2 ” are measured parameters. “w” is the water content of soil specimen, “ $|T|$ ” is the absolute value of freezing negative temperature, “n” is the numbers of freeze-thaw cycles.

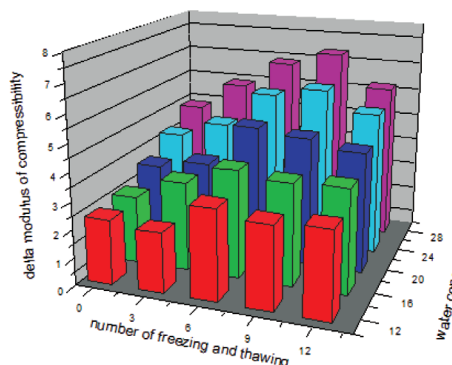


Figure 10 – Modulus of Compressibility Loss Varying with Water Content and Numbers of Freezing and Thawing ($T=-15^{\circ}\text{C}$)

Through the above analysis, constitutive model of compressibility of soil under freeze-thaw cycle can be summarized as follows:

$$\left\{ \begin{array}{l} s = ae^{1+w} np + b \\ E_s = E_{s0} - \Delta E_{si} = (L_1 w + L_2 |T| + \frac{w}{n|T|}) n^{\left(\frac{1}{1+e^n}\right)} \\ \varepsilon_{si} = \frac{P_i}{E_{s0} - \Delta E_{si}} \end{array} \right. \quad (11)$$

a,b are the measured parameter

4. Conclusion

Through thawing and settlement test under different freezing temperature, it is analyzed and concluded that thawing-settlement coefficient increases with the decrease of freezing temperature, and shows a good linear relationship with the absolute value of freezing negative temperature. Higher water content means bigger thawing-settlement coefficient.

1. Freeze-thaw cycles has significant influence on the variation of thawing-settlement coefficient, one cycle of freezing and thawing ($3 \leq n \leq 6$) has the most unfavorable state of frozen soil settlement. With the increased numbers of freeze-thaw cycles, the thawing-settlement coefficient starts to decline from the ceiling, and the settlement inclines to be stable after eleven cycles of freezing and thawing. As a result, it is recommended in this paper to apply the value of thawing-settlement coefficient bigger than one time of freeze-thaw cycles to make the engineering inspection on frozen soil. If possible, original soil specimen shall be frozen and thawed for 3 to 6 cycles in the constant tank, examine and measure the thawing-settlement coefficient by following standard measures, thereby ensuring more scientific and safe to make calculation of settlement estimates.

2. In this paper, the relational expression for calculating the settlement has considered the influence of variation law of soil compressibility, water content, numbers of freezing-thawing cycles on the soil compression, thus working out the equation for calculating the deformation of thawed soil. This equation is built on the basis of test, which is of great practical use and well-oriented purpose.
3. The freeze-thaw cycle also has great influence on the thawed soil compressibility. With the increase of numbers of freezing-thawing cycles, modulus of compressibility loss of soil specimen is ever-increasing, which indicates that the damage ratio on the internal structure of soil material in unit volume is also increasing. Modulus of compressibility loss of soil material gradually inclines to be stable until through six numbers of freezing and thawing.

At last, the finite element method can be employed to calculate the soil deformation aided by mathematical model, it remains hard to be widely applied in practical engineering, as restrained by the suitability of all models and the reliability of soil property parameters.

In this paper, the equation for calculating frozen soil deformation under different loads through freezing-thawing cycles is proposed and built via test, which has considered the influence of numbers of freeze-thaw cycles, water content and modulus damage. It involves less parameters and features easy operation with great potentials of application and promotion.

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Research on Banking Customer Management System of Commercial Banks Based on Data Mining Technology

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Abstract: with the technological advancement and internet development, CRM has gradually transformed into a new business concept from the management theory system. The financial industry has made remarkable achievements in the implementation process of CRM system by relying on its strong technical support. The data warehouse has replaced the database gradually to become the main information carrier of data mining applied in CRM system. This paper described the decision tree algorithm among various data mining algorithms, improved the classical ID3 algorithm in the decision tree algorithm by introducing the rough set and then designed a customer classification algorithm based on the decision tree algorithm. The bank credit card issuance training samples were adopted to conduct empirical study on the algorithm. It was found that the improved ID3 can consider the whole data set with certain advantages on the efficiency by comparing the ID3 with the improved ID3 method. This method based on the decision tree's customer classification can better satisfy the practical needs of banking industry to conduct classification analysis on the customers.

Keywords: CRM; ID3 algorithm; customer classification; data mining.

1. Introduction

The bank must provide the customers with high-quality and individual service so as to obtain the competitive advantages. Therefore, the banking industry in China shall improve the service quality and expand the business variety by implementing the customer relationship management (CRM) based on the data warehouse and starting from the customer satisfaction aiming to cope with the upcoming fierce competition with the foreign banks. The data mining must be adopted to find some useful knowledge in such mass data. The data mining in CRM refers to the model to describe and predict the customer behaviors by using the data mining theory and technology so as to achieve effective customer relationship management. The data mining is capable of statistics and machine learning (Shah S M., Joshi N R., Sebastain R., 2015). With the development of information technology, Oracle Company proposed the customer relationship management schemes with three important components. That is to say, interactive service entry, market, sales and service management as well as memory model and

business intelligence analysis that conforms to the complex customer relationship in the real economic world (Akhondzadeh-Noughabi E., Amin-Naseri M R., Albadvi A., 2016).

SAP Company focused on two parts aiming at the customer relationship management; one, customer information management system; two, marketing management. The CRM scheme of IBM Company is characterized by self-service website, Front office CRM application, system integration and commercial intelligence (IGP C R M., 2015). The Microsoft CRM can be integrated with Microsoft Office Outlook perfectly, which can strengthen and improve the sales, market and customer service process comprehensively and provide the customers with strong and complete solutions to customer relationship management. A part of banks have obtained certain achievements on information data storage (Conteh N Y., Akhtar M J., 2015). For example, China Merchants Bank registered its credit card customers with rather obvious real effects. The China Construction Bank started to use VIP customer service system in 2002. The Industrial and Commercial Bank of China also started to use PCRM system to register the customer data (Demo G., fogaça N., ponte V., 2015). Further, the Agricultural Bank of China started to build the high-quality customer management system in 2004 and planned the implementation in various branches (Galandiuk S., 2015). It indicated that the application and researches on data information among the domestic banking industry have been improved continuously. More new products will be developed to service the customers. This paper simply described the decision tree algorithm in data mining, then clarified various decision tree algorithms, analyzed the customer samples with the known customer classification results and then put forward a customer classification algorithm based on the decision tree by introducing the core (Cruz-Cunha, M. M., Simões, R., Varajão, J., & Miranda, I., 2014).

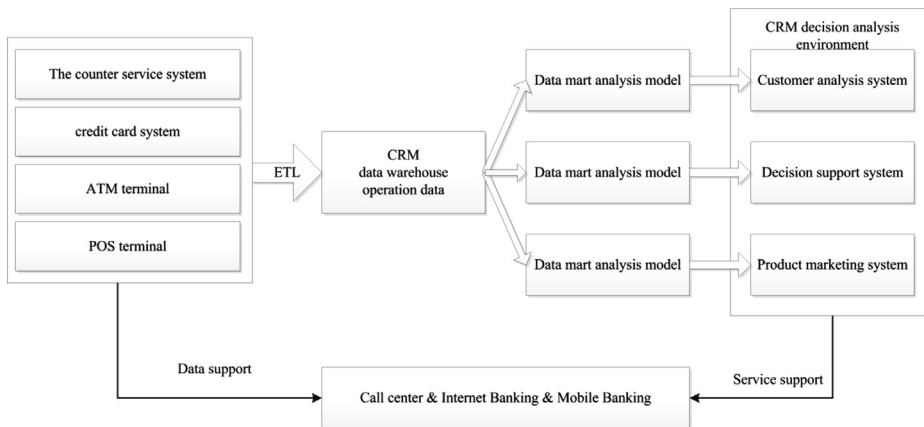


Figure 1 – CRM frame diagram

2. Simple Description on the Decision Tree Algorithm in Data Mining

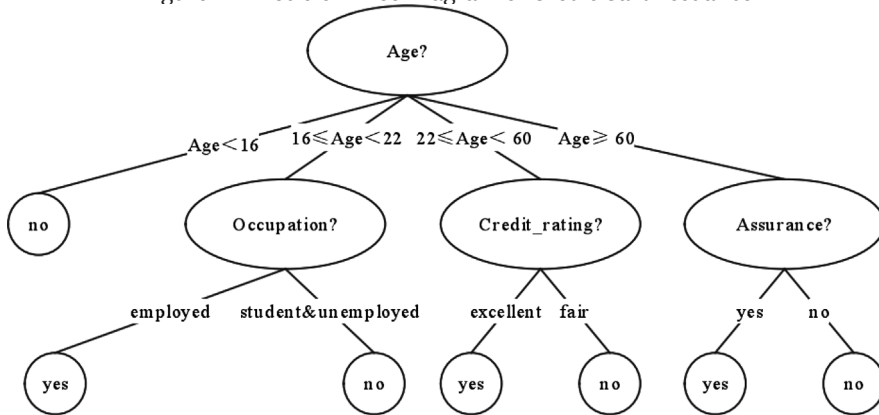
The decision tree is an effective method for data classification, which means to find out the classification rule from a set of unordered and ruleless data set. The decision tree classification method adopted the recursive fashion from top to bottom. The vertex is the root node of the whole tree, which represents one attribute. The judgment on root

node is equal to the judgment on this attribute, which is commonly represented by oval. According to the judging results, different branches were led from the root nodes with each representing a kind if output of judgment. The branches will point down to the internal nodes or leaf nodes. Then the attribute judgment was conducted on the internal nodes to reach the conclusion on the leaf nodes. In general, the internal nodes are represented by ovals, while the leaf nodes are represented by circles. The path from the root node to leaf node of decision tree corresponds to a conjunctive rule. The whole decision tree corresponds to a set of disjunctive expression rule. A typical decision tree, see fig2; it represents credit card issuance and judges whether the customer meets the credit card issuance requirements (Tudor E., Oliphant Z., Marshall M., 2015).

The following rules can be seen intuitively from figure 2:

1. The customers younger than 16 years shall not be allowed to issue the credit card;
2. The occupation shall be judged for the customers between [16, 22]. If with stable works, the bank will issue the credit card. If without stable works or students, then the bank will not issue the credit card;
3. The credit record shall be judged for the customers between [22, 60]. If with good credit record, the bank will issue the credit card. On the contrary, the bank will not issue the credit card;
4. For the older customers ≥ 60 years, if with guarantee, the bank will issue the credit card. On the contrary, the bank shall not issue the credit card;

Figure 2 – Decision Tree Diagram of Credit Card Issuance



It can be seen that the decision tree algorithm simply clarified the main factors relevant to the customers in the credit card issuance process. Besides, the decision tree is widely applied with many decision tree algorithms including ID3 algorithm and C4.5 algorithm (Shayegh M B., Kuzegar G., Faridchehr E., 2015) etc.

3. Decision Tree Algorithm

The decision tree adopted the sample's attributes as the nodes, the attribute's value as the branch and then applied the information theory principle to analyze and conclude

the attributes of a large of samples. The root nodes of decision tree refer to the attribute with maximum information among all the samples. The middle node is the attribute with maximum information in the sample set of sub-tree that takes the nodes as the root. The leaf node is the samples' class value.

3.1. Decision Tree Building Algorithm

The algorithm construction lies in a binary or multi-way tree. The internal nodes (non-leaf nodes) of the binary tree are usually represented by a logical judgment. The side of tree is the branch outcome of logical judgment; the internal nodes of multi-way tree refer to the attribute. The side refers to all the values of this attribute with one attribute corresponding to one side. The decision tree building method usually adopts the recursive construction from up to bottom, whose basic thoughts are as follows (Rukhin A L., 2015):

- i. Start to build the tree from the single nodes of training samples.
- ii. If the samples belong to the same category, then this node becomes the leaf with the tag.
- iii. Or else, the algorithm takes the measurement based on entropy of information gain as the heuristic information and then selects the attribute that can best classify the samples. Then it becomes the “test” or “judgment” attribute of this node.
- iv. Establish a branch for every known value of test attribute and then classify the samples based on the above mentioned.
- v. Use the same process to form the sample decision tree recursively. Once an attribute appears on a node, any descendant of this node shall not be considered.
- vi. Divide each step recursively and then stop the division with one of the following conditions: (1) all of the samples of given nodes belong to the same category; (2) the majority voting shall be adopted if without any residual properties to further divide the samples; (3) when the branch test attribute= a_i but without samples, build a leaf by using the majority class in the samples (Sanjaya R., Sumarwan U., 2015).

3.2. ID3 Algorithm

As a set of integrated data without any rules or orders, the decision tree is like a tree with reverse growth, which also refers to a tree generated by adopting the recursive method. Quinlan put forward the famous ID3 algorithm in his article *Introduction of Decision Trees* in 1986. The ID3 was defined as follows: (1) every non-lead node in decision tree corresponds to a non-category attribute. The branch refers to the value of this attribute; a leaf node represents the categorical attribute value corresponding to the record of path from the tree root to the leaf nodes; (2) every non-leaf node is related to the non-category attribute with the maximum information among the attributes; (3) the information gain is adopted to select the best attribute to classify the samples.

It can be seen that ID3 algorithm will always select the attribute with the highest information gain (or the largest entropy compression) as the test attribute of the current node. Let S as the set of s data samples, assume the class tag attributes have m different values and define m different classes C_i (of which $i = 1, 2, \dots, m$). Let s_i as the sample number of class s_i . The required expected information for one given sample classification was as follows.

$$I(s_1, s_2, \dots, s_m) = - \sum_{i=1}^m p_i \lg(p_i) \quad (1)$$

Of which, the possibility of any samples belonging to C_i was $p_i = s_i / s$; assume that the attribute A had v different values including $a_1, a_2, \dots, a_j, a_v$. Use attribute A to divide S into v subsets $\{s_1, s_2, \dots, s_j, s_v\}$, of which s_i includes the samples in S with value a_i on A. If taken A as the test attribute, then those subsets correspond to branches generated from the nodes of set S.

Let assume s_{ij} as the number of samples of class C_i in subset S_j , then the entropy of subset divided by A was as follows:

$$E(A) = - \sum_{j=1}^v \frac{s_{1j} + s_{2j} + \dots + s_{mj}}{s} I(s_{1j}, s_{2j}, \dots, s_{mj}) \quad (2)$$

Of which, $\frac{s_{1j} + s_{2j} + \dots + s_{mj}}{s}$ acted as the weight of the j th subset, which is equal to the number of samples/total number of samples in S of subset (namely A value as a_j). The smaller of the entropy value, the higher fitness of the subset division. The corresponding information gain value can be obtained from formula (1) and (2). The information gain of branches on A was as follows:

$$Gain(A) = I(s_1, s_2, \dots, s_m) - E(A) \quad (3)$$

The ID3 algorithm was applied to calculate the information gain of each attribute. Then the attribute with the highest gain was selected as the test attribute of the given set S. Further, a node was built for the selected test attribute. Then label it by this attribute. Build the branch for each value of this attribute and then divide the samples according to this branch.

3.3.C4.5 Algorithm

C4.5 algorithm was evolved from ID3 algorithm. Except for the functions of ID3 algorithm, C4.5 algorithm also introduced new methods and added new functions. For example: (1) put forward the concept of information gain ratio; (2) merge the values with continuous attributes; (3) can deal with the training samples that lack of attribute values; (4) can avoid the overfitting by using different pruning technologies; (5) k cross validation; (6) rule generation method (Reitsma D J., 2015).

The information gain ratio was developed based on the information gain concept, whose attribute's information gain ratio was $GainRatio(A) = \frac{Gain(A)}{SplitI(A)}$, of which

$SplitI(A) = - \sum_{j=1}^v p_j \lg(p_j)$. The attribute A had v different values $\{a_1, a_2, \dots, a_v\}$, which can divide S into v subsets $\{S_1, S_2, \dots, S_v\}$. The S_v included some samples in S.

3.4. Decision Tree Pruning

The decision tree pruning can cut off some unreliable branches via some measurements so as to prevent the data over-adaption. The pruning can be divided into pre-pruning and post-pruning. The pre-pruning means to do the pruning by stopping the tree's construction. Once stopped, the nodes will become the leaf nodes; the post-pruning means to cut off the branches from the trees with complete growth. Different measurements can be adopted to evaluate the validity of branches in the decision tree pruning so as to determine the pruning (SALIYA D A., 2015).

4. Research on Banking Customer Classification Based on Decision Tree

The bank customer classification algorithm inherited ID3 algorithm's advantages and then improved its disadvantages that only work for rather small data set. This paper introduced the attribute reduction in rough set and then put forward the attribute core in the new algorithm. This paper firstly provided some related definitions as follows (Wurz G T., Kao C J., DeGregorio M W., 2016):

Definition 1, the attribute $\alpha_k \in C (1 \leq k \leq m)$ was existed as the object decision in the information system $IS = (U, C, V, f)$, which is called as decision attribute; the attribute $\alpha_k \in C (1 \leq k \leq m, j \neq k)$ provided support for the decision attribute, which is called as condition attribute.

Definition 2, if any subset A in non-empty finite set U of object in information system $IS = (U, C, V, f)$ can not divide some object areas in non-empty finite set U, then the subset A is not identified and recorded as $IND(A)$.

Definition 3, for each attribute $\alpha_k \in C (1 \leq k \leq m)$ in information system $IS = (U, C, V, f)$, if delete the attribute α_k to hold $U / IND(C - \{\alpha_j\}) = U / IND(C)$, then the attribute α_j is not necessary in C; delete the unnecessary attributes α_j , merge the duplicate lines and then repeat the above steps until no duplicate lines, then the residential property set is the reduction of information system attribute set, recorded as $RED(C)$. On the contrary, if delete the attribute α_j to hold $U / IND(C - \{\alpha_j\}) \neq U / IND(C)$, then the attribute α_j would be the necessary attribute in C, which is also called as the core of information system attribute set and recorded as $CORE(C)$. Certainly, there is an argument to be made that the reduction of attribute is not unique, but the core of attribute is unique.

Definition 4, in $P \cup Q = C$ with known $P \cup Q = C$ and $P \cap Q = \Phi$, let assume P is the condition attribute set of object U and Q is the decision attribute set of object U; let $U / IND(P) = \{A_1, A_2, \dots, A_n\}$, $U / IND(Q) = \{B_1, B_2, \dots, B_n\}$, then

$$Z_i = \bigcup_{A_i \in U / IND(P)} A_i \subseteq B_j, Z_{n+1} = \bigcup_{A_i \in U / IND(P)} A_i \not\subseteq B_j \quad (4)$$

Then $\{Z_1, Z_2, \dots, Z_{n+1}\}$ was called as the generalization of P corresponding to Q, which was recorded as $GEN_Q(P)$;

The condition attribute can be divided into m different classes including $M_i = (i=1, \dots, m)$ in information system $IS = (U, C, V, f)$. The system has n objects; P_i refers to the possibility of any objects in U belonging to M_i ; the example belonging to category M_i was M_{ij} ; the number of examples belonging to M_i was represented by $|M_{ij}|$, then $P_i = |M_{ij}|/n$. The expected information required by the object classification in the information system was as follows.

$$\text{info}(U) = -\sum_{i=1}^m p_i \log_2(p) \quad (5)$$

At present, assume to divide the objects in set U according to attribute A , then it can be known through observation that the attribute A had v different values including $\{a_1, a_2, \dots, a_v\}$. Therefore, the object U can be divided into v subsets $\{U_1, U_2, \dots, U_v\}$, of which the samples of each subset had the same values on attribute A . This division can not obtain the accurate classification. The following measurement was further required:

$$\text{Info}_A(U) = \sum_{j=1}^v \frac{|U_j|}{|U|} \times \text{Info}(U_j) \quad (6)$$

Of which, $|U_j|/|U|$ represented the weight of the j th division. $\text{Info}_A(U)$ is the expected information required by object U based on attribute A . The smaller of required information, the higher of division purity; the information gain obtained from the branches on attribute A was

$$\text{Gain}(A) = \text{Info}(U) - \text{Info}_A(U) \quad (7)$$

Quinlan's ID3 algorithm means to select the attribute with the maximum information gain as the condition attribute, while the customer classification algorithm proposed in this paper firstly found out the core of the attribute. If the core of attribute is empty, then calculate the information gain and construct the decision tree according to ID3 algorithm; on the contrary, if the core of attribute is not empty, then calculate the generalization of attribute core corresponding to the decision attribute. The specific customer classification algorithm pseudocode was as follows;

Input T: table // Training data

C: classification attribute //Class attribute

Output decision tree //decision tree

BEGIN

IF (T is empty) THEN return null;

FOR remove each attribute A in T in sequence merge duplicated row;

Compute core (A); //Computing attribute's core

```
N = core (A); //The kernel of the attribute is the root node of the tree
IF N!= null THEN compute GEN(N); //Generalization of computing decision attribute
ELSE BEGIN
  IF(there are other attributes in T than core (A))
  THEN label N with V; //If no residual property is divided, the N tag is a category V
  ELSE BEGIN
    FOR each attribute A in T except core (A)
    Compute Gain (A); //Calculating information gain values for residual properties
    V= the attribute for which Gain (A) is maximum; // Mark the maximum value of the
    information gain value to V
    Label N with V;
    FOR each value of V DO BEGIN
      N1 = ID3 (SUBTREE (T, A, V), C);
      IF (N1! = null) THEN
        Make an arc from N to N1 labeled V;
    END // Recursive calls, if the new leaf node is not empty, then continue to split the tree
  END
END
RETURN N; // Return tree
END
```

5. Comparison between This Paper's Algorithm and ID3 Algorithm

This paper extracted partial data from the credit card system of some bank and then processed the data set correspondingly to transform the date of birth into three age stages including ≤ 25 years, 25-50 years and > 50 years, divide the income status into three types including High, Medium and Low, the occupation into two types including employed and unemployed and the credit status into two types including Excellent and Fair. The formulated training samples are showed in table 1.

According to the sample data, the decision tree constructed by applying ID3 algorithm, see figure 3; the decision tree constructed by applying the algorithm proposed in this paper, see figure 4.

The attribute core shall be found in the training set to play the key role. Define the tree's root node as the attribute core and then start from the root node. Next, find out the internal nodes according to the property of decision attribute aiming to seek for a classification decision tree that can better conform to the practical needs. The core of attribute plays a key

No.	Age	Renue	Job	Credit	Card
1	25 < age ≤ 50	High	employed	Excellent	Yes
2	25 < age ≤ 50	Medium	employed	Fair	No
3	age > 50	High	unemployed	Fair	No
4	age ≤ 25	Low	unemployed	Excellent	No
5	age > 50	Medium	unemployed	Fair	No
6	age ≤ 25	Medium	employed	Excellent	Yes
7	age ≤ 25	Low	employed	Fair	No
8	age > 50	High	employed	Excellent	Yes
9	age > 50	Medium	employed	Excellent	Yes
10	age ≤ 25	Medium	unemployed	Excellent	Yes
11	25 < age ≤ 50	Low	unemployed	Excellent	No
12	25 < age ≤ 50	Medium	employed	Excellent	Yes
13	age ≤ 25	High	employed	Fair	No
14	age ≤ 25	Low	employed	Excellent	Yes
15	age > 50	Medium	unemployed	Excellent	Yes
16	25 < age ≤ 50	Low	employed	Excellent	Yes
17	age ≤ 25	Low	unemployed	Fair	No
18	25 < age ≤ 50	Medium	employed	Excellent	Yes
19	25 < age ≤ 50	Medium	unemployed	Fair	No
20	age > 50	Low	employed	Excellent	Yes
21	25 < age ≤ 50	Low	employed	Fair	No
22	25 < age ≤ 50	High	employed	Fair	No
23	25 < age ≤ 50	Medium	employed	Excellent	Yes
24	age > 50	Low	employed	Fair	No

Table 1 – Training Sample Data for a Bank's Customer Credit Card

role in the decision tree constructing process. This paper can have a deep understanding on the advantages and disadvantages of two algorithms through observation.

For one thing, the ID3 algorithm only maintain the current assumption in the decision tree constructing process, from which has the risks of obtaining the local optimal rather than global optimal decision tree. Aiming at the customer classification algorithm proposed in this paper, the core attribute that can reflect the whole system was preferentially determined at the beginning of the tree constructing. Based on the core attribute, the decision attribute was taken to determine the middle path so as to reduce the risks of assuming only one path but losing another path.

For another, ID3 algorithm generated a decision tree with deep development, while the customer classification algorithm proposed in this paper means a decision tree with even development towards depth and width. When the decision attribute was determined,

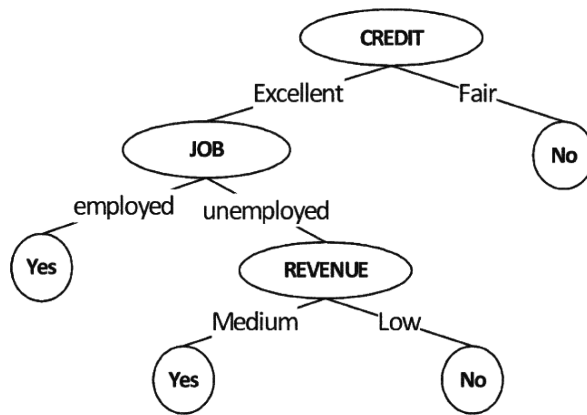


Figure 3 – ID3 algorithm for constructing decision tree

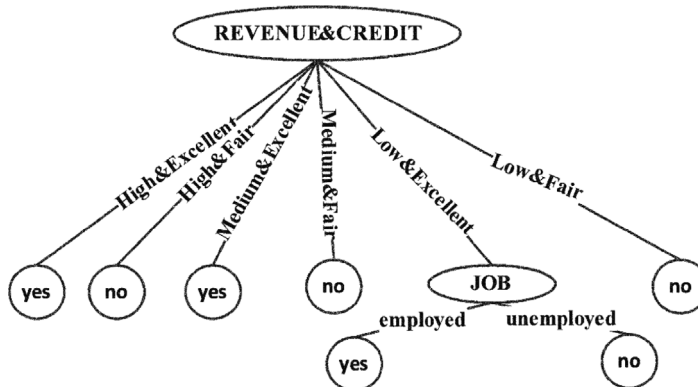


Figure 4 –Improved Algorithm for Constructing Decision Tree

the customer classification algorithm can better satisfy the practical needs of banking industry to conduct classification analysis on the customers.

6. Conclusion

With the technological advancement and internet development, the customer relationship management has transformed into a new business concept from the management theory system gradually. The reasonable and ordered data storage is required to conduct the data mining and find out the customer rules in the mass data aiming to better design CRM system that is suitable for the enterprise demand. This paper described the decision tree algorithm in various data mining algorithms, improved the typical ID3 algorithm in decision tree algorithm by introducing the concept of rough set and then designed a customer classification algorithm based on the decision tree algorithm. The empirical study was conducted on the algorithm through bank credit card issuance training samples. It was found that the newly proposed method could consider the whole set

with certain advantages on efficiency by comparing the previous method with the newly proposed method. The customer classification method based on decision tree in this paper can better satisfy the practical needs of banking industry to conduct classification analysis on the customers, which has significant meaning for the research on banking industry's classification analysis on customers.

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Study on the Complementary Model of Traditional Sports Teaching with Multimedia Technology

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Abstract: With the development of computer technology, multimedia technology and communication technology, new educational patterns represented by educational technology emerge one after another for discussion in Chinese educational field, where multimedia network teaching is a prominent part. By analyzing the characteristics of traditional teaching and multimedia teaching, this study promotes the multimedia network teaching into the college sports teaching to overcome the problems in traditional college sports teaching, and proposes the overall model with structural and functional modules under the design criteria of standard multimedia network teaching platform. With the application of multimedia network teaching platform, the mutual complementation of modern teaching and traditional teaching can be achieved. According to the investigation, the complementary teaching with both multimedia network teaching and traditional teaching can not only create more interest, more efficiency, more effect and more innovation for students, but also better satisfy the needs of students.

Keywords: Multimedia network teaching platform; traditional teaching; complementation.

1. Introduction

With the development of computer technology, multimedia technology and communication technology, new educational patterns represented by educational technology emerge one after another for discussion in Chinese educational field, where multimedia network teaching is a prominent part (Chun-hui Z., Fu L., 2015). As a bilateral teaching-learning activity with strong practice and involvement, the sports teaching owns fewer network resources than other subjects and lacks systematicness and integrity. For sports teaching, the demonstrativeness and imitativeness of actions are well suited for the display form of multimedia contents while the simple multimedia teaching and traditional teaching can hardly meet the needs of students towards sports schools. Therefore, it is necessary to design and develop a sports-oriented multimedia network teaching platform. A Ying-ga and Yao Songping (2008) once analyzed the construction status of network courses for Chinese modern sports education through online surveys [2008]. Chen et al. (2004) conducted questionnaire survey on backbone teachers of sports multimedia technology from 57 high school and 27 provinces, finding that the application of multimedia network teaching in college sports is far less than other subjects (Hong L., Xiaodong L., Ganchen

T., 2015). Chen and Jia utilized literature method, investigation method, comparison method and expert consultation method to specifically expound the basic characteristics of network teaching and the significance of college sports network teaching, and pointed out that the development of multimedia network teaching would change the traditional system which focuses on competitive sports and improve the interest and practical value of sports teaching (Huan W., 2015). Chen Zebing elaborated the traditional sports teaching method and the sports teaching method with multimedia network teaching from aspects of both advantages and disadvantages so as to analyze the complementary strengths of traditional sports teaching and modern multimedia sports teaching (Zhifeng Y., Jianjun X., 2015; HAIM O., 2015). Hu and Xiao pointed out some disadvantages of modern network teaching in the application of sports teaching and some weak points in combining with the subject (Muehlberg F., Neumann D., von Knobelsdorff-Brenkenhoff F., 2015). Multimedia network teaching can not only make up the deficiency of traditional multimedia in class teaching and traditional teaching, but also provide a more distinct and visualized real-time interactive learning platform. The multimedia application system is formed by integrating application software authoring tools like Authorware, Director, Multimedia ToolBook and other media materials (including words, pictures, animation, video and audio) in the form of hypertext nodes and chain structure. As an important means in education modernization, multimedia teaching achieves the combination of modern technology and education teaching and improves the working efficiency of teachers and the learning effect of students. In traditional sports teaching, the sports teaching materials and blackboards are the basic carriers (Wang N., 2015). As the teaching subject, the teacher explains the teaching contents while students passively accept the knowledge and hardly participate in the studying. Consequently, the class becomes the place where the teacher alone has the say, and students have limited ways to acquire learning materials (Shiwen Z., 2015). By analyzing the characteristics of traditional teaching and multimedia teaching, this study promotes the multimedia network teaching into the college sports teaching to overcome the problems in traditional college sports teaching, and proposes the overall model with structural and functional modules under the design criteria of standard multimedia network teaching platform. With the application of multimedia network teaching platform, the mutual complementation of modern teaching and traditional teaching can be achieved. Through questionnaire survey and classroom experiment, this paper compares the traditional teaching, the multimedia network teaching and the teaching combined of both (Costa, A. P., Reis, L. P., & Loureiro, M. J., 2014).

2. Characteristics of Traditional Teaching and Multimedia Teaching

2.1. Major Characteristics of Traditional Multimedia Teaching Method

Though traditional multimedia teaching method has effectively improved the effects of classroom teaching, modern multimedia carries more information and broader range in the classroom teaching. Covering the movie and video materials, picture information, audio data and literature resources closely related with the teaching contents, modern multimedia can display all information of teaching contents in a short time, which is fairly effective for improving the perceptibility of students on knowledge learning. Through multimedia teaching, students can obtain more relevant knowledge out of textbooks,



Figure 1 – Traditional Multimedia Teaching

further enriching their means of acquiring knowledge. Moreover, rather than be limited by the classroom textbooks, the multimedia teaching can obtain rich relevant knowledge through multimedia network so as to catch the attention of students, enrich the teaching of students, and further make the classroom teaching lively and interesting. The multimedia teaching here does not mean a single teaching tool but the method that enriches teaching contents, improves students' initiative for studying, broadens learning knowledge and facilitates knowledge understanding through multimedia teaching and network teaching. In the meantime, multimedia teaching greatly improves the teaching methods while enhancing the classroom efficiency (Huang P Y., Chen C M., Tsao N L., 2015).

However, its shortcomings are also obvious, such as difficulty in digesting and accepting the knowledge, easy formation of reading after the network materials and easy distraction of students' attention.

2.2. Major Characteristics of Traditional Blackboard Teaching Method



Figure 2 – Traditional Teaching Methods

The major advantages of traditional blackboard teaching are that it can well coordinate the shortcomings in the teachers' expression of language knowledge, grasp the rhythm of students' acquisition of knowledge and facilitate students to improve studying in various aspects (Fauzi I., 2015).

The major disadvantages of traditional teaching method lie in: (1) the time limitation of traditional blackboard teaching; (2) the shortcomings of blackboard teaching in the expression of abstract knowledge; (3) “what the students are learning cannot meet the needs of their future profession”.

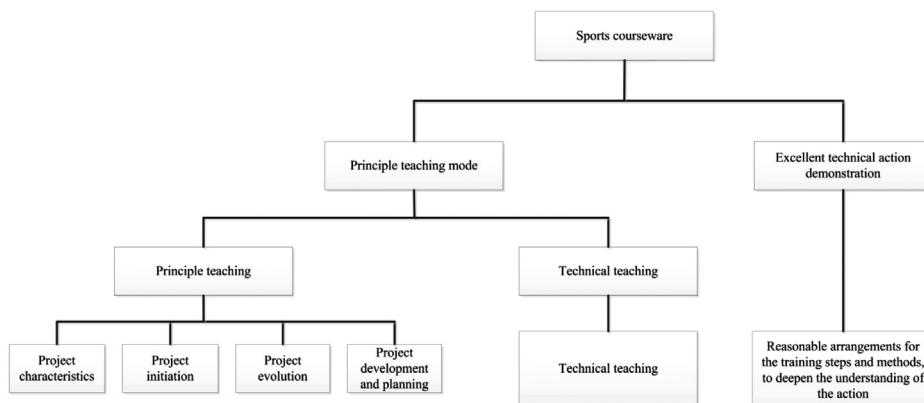


Figure 3 – Traditional Multimedia Sports Teaching Courseware

Though there are some differences in the forms of traditional multimedia teaching and traditional blackboard teaching, they are two indispensable teaching means in teaching process with diverse strengths. Neither can be worshipped as an omnipotent teaching means, nor can they be separated or abandoned. Combined with the merits and demerits of traditional multimedia teaching and traditional blackboard teaching, this paper puts forward the multimedia network teaching and further deepens the advantages of traditional multimedia teaching so as to provide autonomic learning opportunity for students in free time and further help students to study. With the openness and interaction, multimedia network teaching cannot be compared with the traditional teaching. Famous for its rich resources and powerful functions, multimedia network teaching stresses to center at students to run through the whole teaching process (Crawley K L., 2015).

3. Components of Sports Multimedia Network Teaching

Based on thinking activity of students and teachers, the sports practice teaching mainly spreads knowledge, techniques and skills through body movement. With this feature, sports teaching can take advantage of powerful multimedia teaching information resources in multimedia computer network to develop the traditional teaching mode of sports teaching into network teaching mode so as to gradually build a multimedia network teaching platform with complete functions. Network teaching objective is indispensable from any teaching activity. As the wind vane for the operation of multimedia network teaching, the expected teaching results must be pursued in implementing teaching activities in the network. According to the educational policies and the overall school sports objectives in China, the sports teaching goal at present is to deliver sports and health care knowledge as well as sports technologies and skills so as to promote health, strengthen physique, develop the physical quality and cultivate sports ability and fine

ideology and morality of students. This objective is also of extensive application value in the multimedia network teaching (Delli R., Abed Shakeh N., Dumanig F P., 2015).

As the premise for implementing multimedia network teaching, the network technology environment limits the implementation of multimedia network sports teaching mode with the performance of internet, wide-area network, local area network, campus network and various hardware devices as well as the conditions of information transmission. Compared with the traditional sports teaching mode, fine technological environment can facilitate the overall implementation of sports teaching activities, which reflects the unique characteristics of network teaching (Fortune T W., Tedick D J., 2015).

The relationship between “human” and “machine” is the important component in the multimedia network sports teaching mode, where “human” refers to the educators and learners; “machine” means the technical environment of multimedia devices and network devices; and the human-machine relationship includes teacher-student relationship and their relationship with the computer network (Carhill–Poza A., 2015).

4. Establishment of Multimedia Teaching Platform

4.1. Basic Structure and Working Principle of the Multimedia Network Teaching Platform for Sports

Multimedia network teaching platform usually adopts the latest B/S (browser/server) structure whose chart is shown in Figure 4-2. The structural features are as follows: the environment applied the client is the standardized and general web browser, where all applications are stored in the Web server which can be directly downloaded when needed; it is easier for management and maintenance, for the client can upgrade the network application without special software but by just updating the software in the server; such structure is featured with fine extensiveness and open. As B/S structure applies the standard TCP/IP communication agreement, the schools can extend the system at any time according to their own development (KIM Y., TAGUCHI N., 2015).

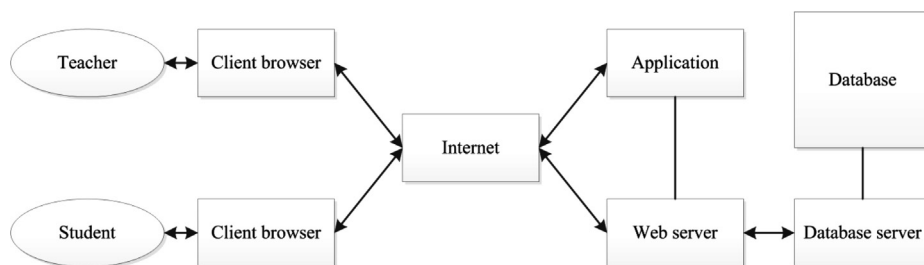


Figure 4 – Structure of Multimedia Network Teaching Platform

The working principle of this system: teachers and students can access multimedia network teaching platform through browser. Students can utilize personal computers to connect to the server through browser and conduct inquiry on learning and sports resource information related with sports teaching, or timely communicate with teachers, update personal data, and so on. The managers and college sports teachers of multimedia network teaching platform can update and maintain the contents stored in the server

through browser on the server and upload the latest information of physical education resources to the server, while answering questions online for students and guiding their sports practice. The server is composed by the Web server and database server. Specifically, the different application modules of the system stored in the Web server can complete the application functions of the client by receiving requests from users, converting them into database requests and interacting with the database server and then download the interactive results in the browser in the form of Web pages. In this way, the users can observe the request results. The system database and management software needed in the storage system of database server operate according to the requests from the Web server, and transmit the results to the Web server.

4.2. Supporting Environment Structure of the Multimedia Network Teaching Platform for Sports

The promotion of multimedia network teaching platform in the teaching of college sports is inseparable from the construction of platform environment. According to the supporting system of modern distance education teaching in *Technical Specifications of the Construction of the Modern Distance Education Resources*, this paper proposes the supporting environment structure chart for the multimedia network teaching platform of college sports.

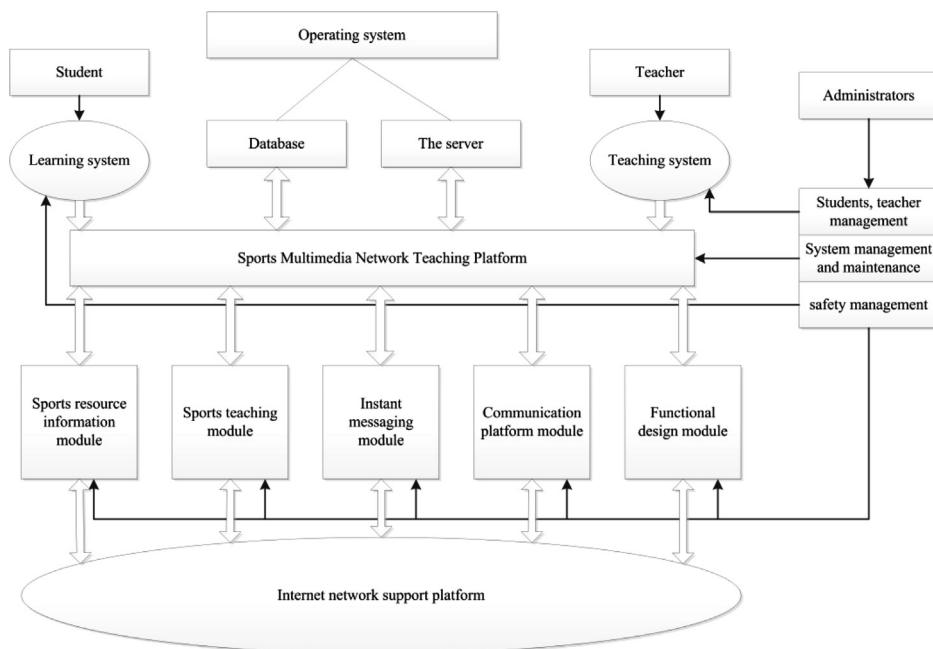


Figure 5 – Support Environment Structure of the Sports Multimedia Network Teaching Platform

4.3. Module Application of the Multimedia Network Teaching Platform for Sports

Multimedia network teaching platform is a system integration of college sports teaching developed based on the Internet. It is not only a platform for college students to

autonomously learn and exchange personalized sports knowledge, but also an effective carrier to facilitate the daily sports teaching in colleges and universities.

According to the multimedia network teaching platform designed based on the characteristics of college sports, at least the following modules should be possessed in the promotion process:

1. Physical resources information module

The main role of this module is to integrate the latest sports information resources in the Internet. By “Computer Robot” (a machine spider program), it will retrieve the latest sports information and information resources in major sports Internet websites and publish them in the module for students and teachers to get the latest sports data and resources information. This module allows students and teachers to learn the latest sports information, and watch online videos of all large-scale sports events. Schools may also make use of this module to publish relevant information regarding school sports

2. Sports teaching module

As the core module of college sports multimedia network teaching platform, the main function of sports teaching module is to display and assist in the teaching process of college sports. This module contains sub-modules of the course introduction, electronic teaching materials, teaching plans, multimedia network courseware, live teaching, instruction videos (including the excellent course show), and curriculum resource collection. Through teaching modules, teachers can edit and upload the teaching information resources, and students can understand the physical education curriculum for autonomous learning. With multimedia network courseware, the more difficult technical actions in the sports teaching process can be displayed through visualized multimedia animation so as to facilitate students to better understand and master the action essentials. Through the implementation of multimedia teaching platform, the sports teaching process can be viewed through remote online, and thus other colleges with relatively lagging sports teaching resources can also learn sports courses through this module. Teaching videos are beneficial for students to review after class and enhance memory.

3. Instant communication module

Instant communication module is the main system to achieve instant communication of teaching information in the teaching process, which enables the instant communication between teachers and students, timely FAQ and online instruction. Meanwhile, it is also the main platform for experts and sports lovers to guide and communicate each other.

4. Communication platform module

The module mainly realizes the sports knowledge exchange and discussion through electronic bulletin board, forum, Email, and online communication software.

5. Functional design module

This module is used as the places where teachers and students can upload and download sports-related resources and information.

5. Comparative Analysis of Students' Attitudes Towards Teaching Methods

As an important supplementation to traditional physical education, multimedia teaching is also an important means of teaching, but both methods are with advantages and disadvantages in sports teaching. In order to understand the different views of students about the two teaching methods, questionnaire surveys are implemented to investigate the students' attitude towards the two teaching methods. The questionnaires of 1800 copies were distributed randomly, where 1740 copies were recollected with a recovery rate of 96.7%. The survey tool is the physical education situation interest scale (PESIS) Chinese version. The results of Chinese revision of PESIS proved the fine reliability and validity. SPSS17.0 software was adopted for the survey data and T tests were conducted for two independent variables.

Survey items	F-measure			P
	Traditional teaching	Multimedia network teaching	Traditional and Multimedia network teaching	
<i>Study interest</i>	0.364	0.729	0.932	<0.05
<i>Serious degree</i>	0.502	0.539	0.753	>0.05
<i>Learning efficiency</i>	0.485	0.627	0.809	<0.05
<i>Learning effect</i>	0.374	0.674	0.799	<0.05
<i>Degree of innovation</i>	0.248	0.732	0.892	<0.05
<i>Degree of satisfaction</i>	0.353	0.520	0.712	<0.05

Table 1 – Students Attitudes in the Questionnaire

Note: the F value represents the integrated attitude coefficient, and P value refers to the Chi-square value.

Cognitive psychology believes that attitude is the internal factor determining study, for students will get better grades with positive attitudes, but underachieving grades with negative attitudes. According to the survey, students hold different attitudes for the different teaching methods in different research projects. By comparing the traditional teaching, the multimedia network teaching, the combination of both teaching methods, this paper concludes that, the complementary teaching method of traditional teaching and multimedia network teaching can not only create more interest, more efficiency, more effect and more innovation for students, but also better satisfy the needs of students.

6. Conclusions

As a bilateral teaching-learning activity with strong practice and involvement, the sports teaching owns fewer network resources than other subjects and lacks systematicness and integrity. For sports teaching, the demonstrativeness and imitativeness of actions are well suited for the display form of multimedia contents. Therefore, it is necessary

to design and develop a sports-oriented multimedia network teaching platform based on the relatively mature campus network, as well as Internet technology, computer technology, multimedia technology, and modern communications technology. By analyzing the characteristics of traditional teaching and multimedia teaching, this study promotes the multimedia network teaching into the college sports teaching to overcome the problems in traditional college sports teaching, and proposes the overall model with structural and functional modules under the design criteria of standard multimedia network teaching platform. With the application of multimedia network teaching platform, the mutual complementation of modern teaching and traditional teaching can be achieved. Through questionnaire survey and classroom experiment, this paper compares the traditional teaching, the multimedia network teaching and the teaching combined of both. According to survey, the complementary teaching method of traditional teaching and multimedia network teaching can not only create more interest, more efficiency, more effect and more innovation for students, but also better satisfy the needs of students. The promotion of multimedia network teaching platform can not only complement the advantages of traditional college sports teaching and better improve the college physical education, but also be a learning platform for students to conduct autonomous learning and personalized learning.

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The Study and Application of Computer 3D Graphics Technology to Management Informationization in the Whole Process of Construction Costs

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Abstract: In recent years, with the continuous rising of costs of labor, material, machinery and so on in the construction field, the management of construction costs faces huge challenge. In the process of construction costs, the calculation of construction quantity is the hardest task. In the traditional way, manual calculation and 2D graphics would bring workers much trouble. The technologies of computer 3D graphics and information modeling could effectively solve the problems in the process of construction costs with 2D graphics. Based on high-speed and high-capacity computer handling, computer 3D graphics technology makes construction costs work much easier, with construction data and costs data in high-speed computer management model instead of calculation of construction quantity. This thesis has conducted study on application of computer 3D graphics technology to the whole process management of construction costs of a museum. The study has shown that faced with large quantity of data in the construction costs process, computer 3D graphics technology could quickly handle data at every stage and the computer 3D graphics modeling makes the management of data logically visible, realizing whole process management of construction costs.

Keywords: 3D graphics technology; construction costs; whole process management.

1. Introduction

With the rapid development of information technology, traditional manufacturing industry has started to make use of computer information technology to manufacture or manage. In construction field, however, the application of information technology is still rather narrowed and information technology applied in construction field, most of the time, is to replace manual automated calculation and blueprint design, leading to such problems as project reworking, material wasting and deadline delaying etc (Upadhyay, A., & Singh, A. K., 2016). Thus, how to use modern technology to properly control construction costs is now the urgent matter (Felizardo, V., Sousa, P., Oliveira, D., Alexandre, C., Garcia, N. C., & Garcia, N. M., 2014).

Currently, in the field of construction, the division between design and construction is still clear. DBB mode (Design-Bid-Build) is still the most-applied construction

management mode (Angulo-Ibáñez, A., Beobide, G., Castillo, O., Luque, A., Pérez-Yáñez, S., & Vallejo-Sánchez, D., 2016), resulting in the inefficient information transmission of every stage in the whole construction process, poor communication among participants and difficulty to manage the whole process construction costs (Park, J. H., Kim, H. Y., Jang, G. S., Ahn, D., & Joo, S. K., 2016). Under such circumstances, new technologies and management modes are being explored, such as 3D graphics, LP management mode, IDP management mode and so on (Lee, H., Kim, H., Kim, J., & Lee, J. H., 2016). This thesis, based on analysis of computer 3D graphics technology, has analyzed the application of computer 3D graphics technology in construction costs and proved that computer 3D graphics technology can informationize management at every stage of the whole process of construction costs (Melo, E. G., Carvalho, D. O., Ferlauto, A. S., Alvarado, M. A., Carreño, M. N. P., & Alayo, M. I., 2016).

2. Management Informationization in the Whole Process of Construction Costs

2.1. Construction Costs

Construction costs are price of constructing a project. Three essential factors of construction costs are quantity, price and cost. Main task of construction costs: According to blueprints, quota and list standard, calculate direct costs (labor, material, equipment, construction machine), corporation management costs, measure costs, fees, interests, taxes and so on (Veeramachaneni, G. K., Raj, K. K., Chalasani, L. M., Annamraju, S. K., & Talluri, V. R., 2015).

Personnel involved in construction costs need to be familiar with construction standards, cost quota and relevant management systems and measurement rules of every type of constructions. They also should possess strong construction quantity calculation capability, the ability to compile cost documents (investment evaluation, design cost estimation, revision cost estimation, construction drawing budget, tendering control price (list budget of construction quantity), tendering offer, construction settlement, completion settlement) at every stage of a project, skillful use cost software and manage data and so on (Ferris, M. E., Miles, J. A., & Seamon, M. L., 2016). Thus, personnel involved in construction costs have a large amount of tedious tasks and data quantity is quite large (Arnold, M., Leitzmann, M., Freisling, H., Bray, F., Romieu, I., Renehan, A., & Soerjomataram, I., 2016).

2.2. Construction Costs Software

At present, commonly used software in construction field includes Golden Software, sketchup, Auto CAD, Tarch, 3Dmax, Potoshop, etc (Wahab, S., Razali, R., Ismail, A. K., Kamarudin, M. A., Mohd Tohit, N., Durai, R. P. R., ... & Siraj, H. H., 2015). Up to now; there is a large number of 3D modeling software. Construction-related software mainly includes machinery manufacturing software and industrial molding design software. Commonly used machinery manufacturing software includes Catia, Autodesk, Inventor, SolidWorks, Pro/Engineer, etc. Commonly used industrial molding design software includes Rhino, Alias, Maya, 3Dmax, etc (Dressler, V., 2015). Nowadays, some pioneer engineers, such as Greg Lynn, Bernhard Franken, New York CAP Design Group, dECOi Design Group and so on, are exploring how to realize 3D design in use of industrial

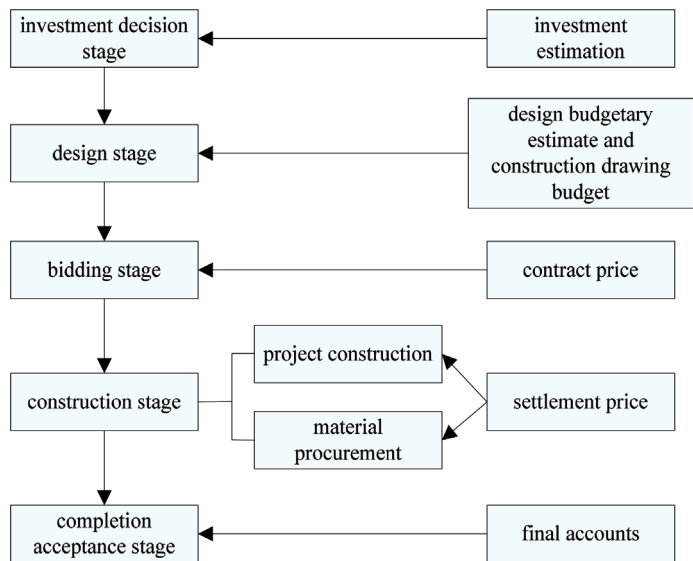


Figure 1 – Each Stage of Cost Management Goals

molding design software (Plank-Bazinet, J. L., Kornstein, S. G., Clayton, J. A., McCaskill-Stevens, W., Wood, L., Cook, N., ... & Begg, L., 2016).

Mostly used construction costs software in China is designed by Beijing Golden Software Co., Ltd. This software adopts project management mode featuring dendritic structure. In the process of setting up a project, it explicitly proposes 3-level management theory--project construction, single project and unit project (Adeleke, O. O., Makinde, V., Eruola, A. O., Dada, O. F., Ojo, A. O., & Aluko, T. J., 2015). In the process of construction costs compiling, it can automatically collect estimation documents of each unit project into comprehensive estimation of one single project and each comprehensive estimation of each single project into overall estimation of the project construction (Sproles, C., & Detmering, R., 2016).

2.3. Whole Process Management of Construction Costs

With high-speed development of information technology, tradition management modes of construction costs have already failed to keep pace with the historical background--information explosion. Informationization of construction costs management has played an important role in construction costs management activities, becoming an essential support in such activities and directing the developing trend of such activities. In China, informationization of costs management now mainly consists of three important parts: counting software, pricing software and price information web sites (Sucheran, R. E. S. H. M. A., 2015).

According to order of construction priority and differences between construction contents and key management points, the whole process of construction can be divided into investment and decision-making stage, design stage, tendering and bidding stage, construction stage, completion and acceptance stage. Only when cost management at

every stage is conducted effectively, can “whole process” construction costs management be realized. There is a function as followed:

$$C = \sum_{i=1}^n C_i, i = 1, 2, 3, 4, 5 \quad (1)$$

In such function: C represents the overall costs of a project; C1 represents construction costs at investment and decision-making stage; C2 represents construction costs at design stage; C3 represents construction costs at tendering and bidding stage; C4 represents construction costs at construction stage; C5 represents construction costs at completion and acceptance stage.

Because key points of work of each stage are different, accordingly, control contents and goals of each stage are different. Following are the cost control goals of each stage in the whole process of construction, shown in figure 1.

3. Application of Computer 3D Graphics Technology to the Whole Process Management of Construction Costs

3.1. Computer 3D Graphics Technology

In recent years, computer 3D graphics technology is widely applied in many fields, such as medicine, aerospace, art, building, etc. Compared with 2D graphics technology, computer 3D graphics technology has shown obvious advantages. Computer 3D technology is to build a virtual reality scene in a computer and according to such scene, and a virtual 3D model is created. In use of the data-handling capability of computer, 3D relations of all components can be analyzed, from which all the relations of each component are collected. Through set computing rules, accurate project volume of each component can be automatically calculated, analyzed and finally acquired.

2D drawings are planar graphs built in 2D coordinate, which is the technology of simplifying 3D information into 2D information to realize communications due to the lack of technologies. 2D drawings are drawn with orthogonal projection method. One projection drawing can only present the projection of one face, so several projection drawings must be drawn to present a 3D product, that is, use three-view drawing to present 3D graphic, shown in figure 2.

At present, 2D design is mostly applied in project design. In terms of examination, however, 2D design has many disadvantages. It is difficult for designers to discover some mistakes at design stage, especially mistakes of special relationship, leading to more changes at project construction stage, delay in project period and more costs in construction, making project investment prices uncertain. Various types of design could bring about huge quantity of data and add more difficulties and troubles to the calculation of project volume. Thus, project volume compiling and examination of construction costs have always been the heaviest task and the informationization of the whole process management of construction costs is hard to be realized. Computer 3D graphics technology effectively solves consistency problems from design to construction to used whole process

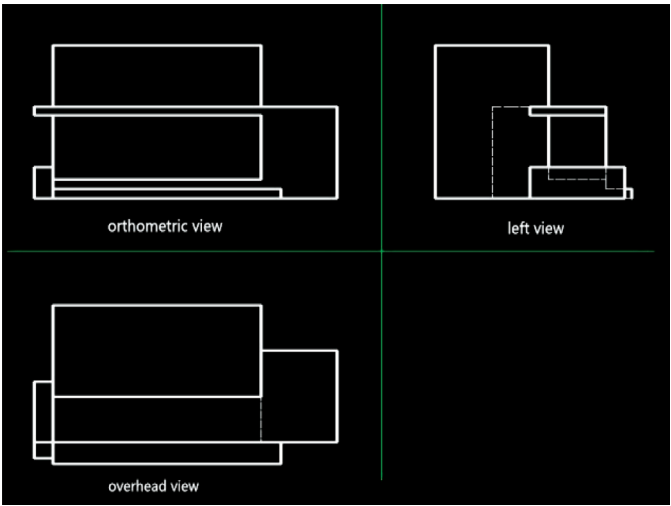


Figure 2 – Three Views

management information, with increased information utilization rate, making clearer the whole process construction costs management.

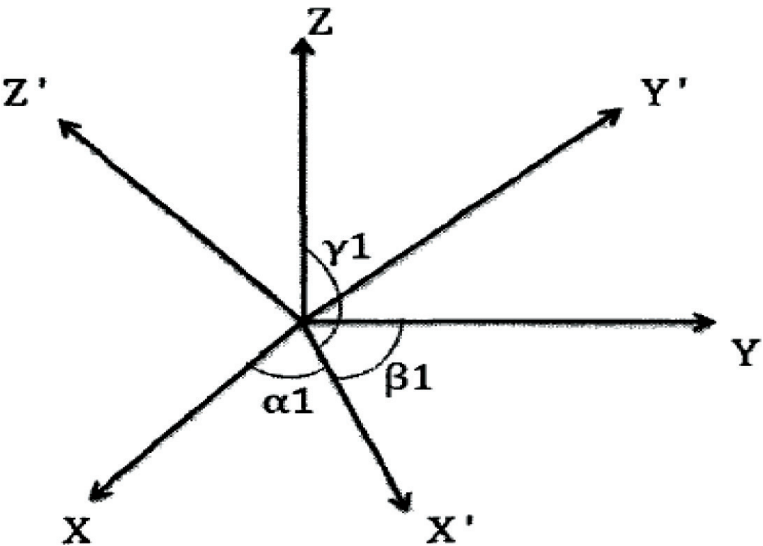


Figure 3 – Three-Dimensional Coordinate

In terms of geometry, 3D coordinate adds one more dimension to 2D coordinate and 3D coordinate can change through calculation. The coordinate of point O in a 3D coordinate XYZ is (x, y, z) and in coordinate O-X'Y'Z' is (x', y', z'), shown in figure 3.

In such coordinate:

The angle between OX' and OX is α_1 , and OY is β_1 , and OZ is γ_1 ;

The angle between OY' and OX is α_2 , and OY is β_2 , and OZ is γ_2 ;

The angle between OZ' and OZ is α_3 , and OY is β_3 , and OZ is γ_3 .

Transformed rectangle is acquired:

$$C = \begin{bmatrix} \cos\alpha_1 & \cos\alpha_2 & \cos\alpha_3 \\ \cos\beta_1 & \cos\beta_2 & \cos\beta_3 \\ \cos\gamma_1 & \cos\gamma_2 & \cos\gamma_3 \end{bmatrix} \quad (2)$$

So:

$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = C \cdot \begin{bmatrix} x \\ y \\ z \end{bmatrix} \quad (3)$$

Counter-transformed rectangle:

$$C^{-1} = \begin{bmatrix} \cos\alpha_1 & \cos\beta_1 & \cos\gamma_1 \\ \cos\alpha_2 & \cos\beta_2 & \cos\gamma_2 \\ \cos\alpha_3 & \cos\beta_3 & \cos\gamma_3 \end{bmatrix} \quad (4)$$

Then

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = C^{-1} \cdot \begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} \quad (5)$$

3D coordinate can rotate. A 3D coordinate, based on x, y, z axis, rotates θ degree (anticlockwise direction is the positive direction), which can be presented in the following matrix:

$$R_x(\theta) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{bmatrix} \quad (6)$$

$$R_y(\theta) = \begin{bmatrix} \cos\theta & 0 & \sin\theta \\ 0 & 1 & 0 \\ -\sin\theta & 0 & \cos\theta \end{bmatrix} \quad (7)$$

$$R_z(\theta) = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad (8)$$

3.1. Design Stage

2D design is to present 3D construction structure according 2D design expression standards onto a planar graph, which is not the natural way of expressing an entity. Drawing construction drawings need professional training and drawings reading also need professional training. Models designed with 3D technology are different. Untrained personnel can read 3D graphics, which is convenient. At the design stage of construction costs, computer 3D graphics technology is adopted to integrate project data models of all the related data in a construction project, which is the detailed expression to such project and it is directly visible. Unlike ordinary effect drawings, this 3D model includes data concerning construction material, equipment, construction and costs. After design is completed, architects, structure engineers, cost engineers, engineers, constructors and proprietors can clearly and comprehensively get the project contents. Construction costs data can be led out as design is finished and design budget can be set after construction data is led into 3D graphics counting software and construction costs software. With 3D graphics technology, the speed of budgeting increases and the quantity of work decreases. The 3D model of a building is shown in figure 4.

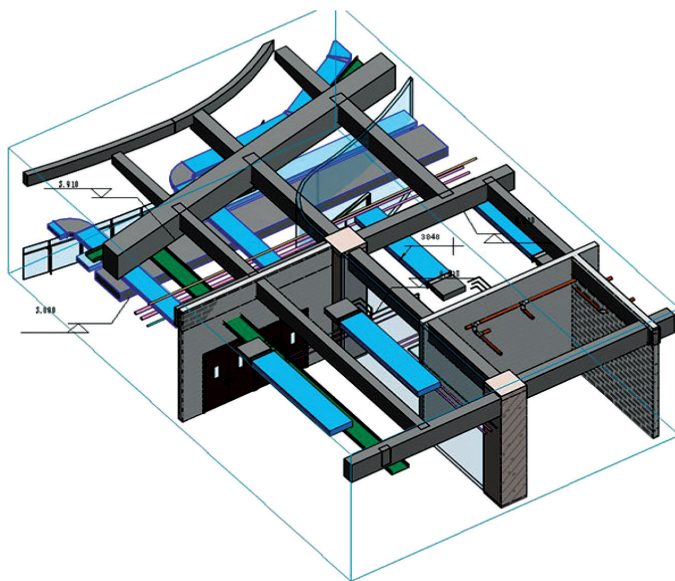


Figure 4 – 3D Design Mode

3.2. Project Tendering Stage

Computer 3D graphics counting software requires accurate graphic size. Because 3D graphics technology is applied at design stage, reuse rate of design results for follow-up work greatly increased. At project tendering stage, renderers lead 3D construction drawings designed at design stage into 3D graphics counting software and they can finish accurate calculation of project tendering with a few alterations and lead out construction volume lists, saving much time. With gradual matching of follow-up cost software and 3D counting software, led-out construction volume lists can be connected

to cost software and data can be directly used by cost software, saving much time in waiting counting results and costs in tendering process.

3.3. Construction Stage

3D graphics technology can synchronously provide data related to construction quality, progress and costs. 3D graphics technology, combined with 3D counting software and construction costs software, can easily provide project volume lists, general budget, material at each stage, equipment, labor and other necessary information in the construction process. In the construction process, with timely calculation and analysis of each project, possible problems in construction management can be easily discovered, which can be under control in advance with altered construction plan, causing few losses finally. Design budget, drawings budget and actual costs can be led out in use of 3D graphics counting software and it also can analyze and compare to find out problems in cost management. Timely and accurate material calculation can reduce the costs of material purchasing and storage and costs caused by period delay because of untimely material support. 3D graphics technology can realize the overall visible model management of the whole construction period, helping construction corporations quantify construction work, timely compare and assess construction volume, find problems and timely rearrange construction plan and cut losses. In communication with proprietors, 3D graphics technology can present them with construction process and progress for much capital and time for construction. After construction is finished, in traditional cases, construction corporations need collect data to draw completion drawings and calculate construction volume after certification, which costs much time. When 3D graphics technology is applied, construction volume can be led out in altered 3D graphics and led in cost software. Settlement report can be quickly generated.

3.4. Construction Settlement Stage

Computer 3D graphics technology can greatly reduce settlement work load. Because the two parties can check according to one 3D graphic and construction data volume of on-the-spot checking can be visually presented in such 3D graphic, the two parties can accurately and quickly check confirmed construction volume according to comparison of construction entity, which reduces costs of labor and time in finishing construction volume checking work.

3.5. Construction Using Stage

Information offered by 3D graphics technology is beneficial to management and using of buildings. With needed usable area and necessary data while renting led out in 3D graphics, it is easy to manage statistics, deriving more benefits from building running and improving cost management levels.

4. System Performance Test and Results Analysis

4.1. Test Data and Results

Computer 3D graphics modeling software can create a geometric figure of a building with dots, lines and faces as much as a building model with walls, doors, windows and other components. What is built and revised on computer is the whole building consisting

of many construction components instead of a pile of unconnected dots and lines, shown in figure 5.

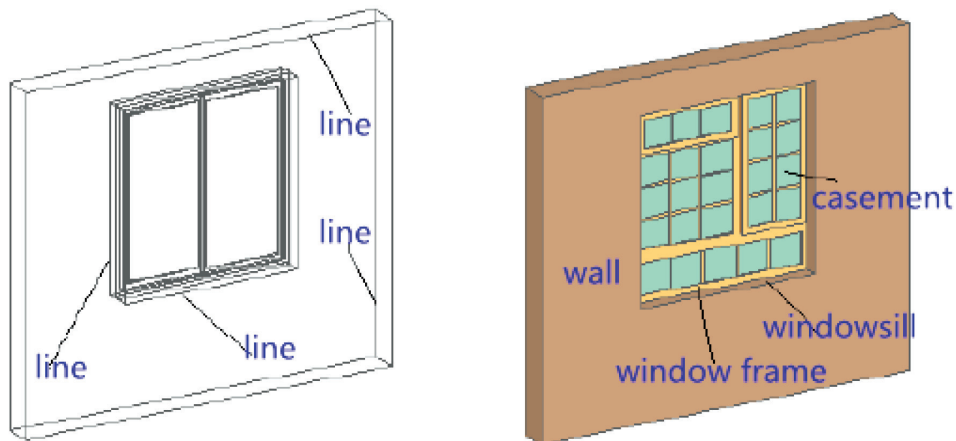


Figure 5 – Comparison of the Building Design Between Drawing Software and BIM Software

Digital objects present real construction components through coding and every object need a series of parameters to describe its attribute. Parameters are usually set in advance or according to certain rules and the information of those parameters consists of the attribute of a building. For example, a wall object is an object contains all the attributes of a wall, including not only geometric information, such as length, width and height, but also material, capacity to preserve and insulate heat, surface treatment, specification, costs and other information. In common CAD drawing software, a wall is presented in 2D way with two parallel lines and the two lines has no connection to each other, so it cannot realize information and data management of construction components. With strong capacity to store and compute data and information, computers can effectively and quickly revise and recalculate 3D model and quickly provide feedback for construction costs system according to calculation rules.



Figure 6 – 3D Drawings Design of the Museum

In figure 6, computer 3D graphics technology is applied to construction design of a museum. Due to special complexity and large volume of the building, traditional drawings bring heavy work load and it is difficult to coordinate each type of work. Thus, before completion of the building, it is necessary to build a digital model of the whole building with the help of 3D software. Software is to virtualize reality. In the construction process, structure, building and equipment clashing often occur. Due to the parallel operation of every type of work, such as building, structure and equipment, actually mismatching problems always appear and these problems can be effectively solved with digital model of the building designed by computer 3D graphics. The study on this large project has shown that in construction field, due to difficulties in information reuse with computer 2D graphics technology, there are great losses in project costs, details shown in table 1.

In the construction process, computer 3D graphics technology can effectively realize information reuse with improved quality and speed of decision-making and strengthened dynamic connection among cost management at every stage and of every participant, realizing the whole process construction costs management. Results of the study on the application of computer 3D graphics technology are shown in figure 2.

Project participator	Planning and design stage	The construction phase	Run maintenance phase	Outside total cost
<i>Architects and engineers</i>	10.2	1.5	1.7	13.4
<i>Contractor</i>	4.9	15.3	5.4	25.6
<i>Subcontractors and suppliers</i>	4.4	12.2		16.6
<i>Owner operating units</i>	7.8	8.0	9.2	25.0
<i>total</i>	27.3	37.0	16.3	80.6

Table 1 – Construction Project Cost Waste Caused by Information Interoperability Difficulties Analysis

Benefits of using	Result
<i>Control the investment estimation error</i>	3%
<i>Save change in the budget</i>	40%
<i>Save the time of investment estimate</i>	80%
<i>Save the project time limit for a project</i>	7%
<i>Save the project total investment</i>	10%

Table 2 – The Benefits of Computer 3 D Graphics Technology

4.2. Advantages of Computer 3D Graphics Technology in the Whole Process of Construction Management

In current construction projects, there is a large number of personnel and information at every stage. With traditional 2D graphics technology, related personnel have heavy

work load and the management of them is tedious and error-prone. Compared with computer 2D graphics technology, computer 3D graphics technology conducts space design and style design under 3D circumstances and provides visible and quantified information management while designing. Applied in construction design, computer 3D graphics technology can improve design quality, increase productivity and broadening designers' thinking.

5. Conclusion

Through analysis of 2D graphics technology and computer 3D graphics technology and application of computer 3D graphics technology at every stage of the whole process of construction costs management, this thesis has proven that computer 3D graphics technology can conduct highly-logical management and quick calculation of the large number of component data in a project and greatly reduce the work load of cost personnel with visible modeling instead of manual calculation. With the development of construction, the number of information of digital building models has experienced exponential growth. With high-speed computers, storage and calculation of a large amount of information can be quickly and effectively finished, greatly improving the working efficiency of construction costs personnel. 3D graphics technology has gradually improved in the field of construction, which alleviating work load and actually realizing the informationization of construction costs management in such field.

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A Study on the Modern Art Design Based on Computer Technology

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Abstract: Since the society is continuously developing and people's life is becoming increasingly diverse, people's pursuits of beauty are diversified. As a result, they demand more for the modern art design. Today, computer has become a necessary tool in people's life and has been widely used in all walks of society. During the process of art design, if the designer can connect computer technology and art design together perfectly, then art design can be well promoted. It will not only provide art designers with new expression ways and modeling languages, but also promote the change of art designing ways. This paper, based on the development history of computer art design, probes deeply into computer's advantages in art design and finally introduces the application of computer technology in art design in great detail.

Keywords: Computer; technology; art design.

1. Introduction

The popularity as well as growth of computer has facilitated all sectors. Computer art design is a brand-new art creation way that integrates design art and computer technology perfectly on the foundation of computer technology. It is a comprehensive subject which combines computer technology and traditional art design. Although computer art design is called in various ways, and at the same time the industry circle interprets the words in different ways, there is one similarity in people's understandings of computer art design: computer art design is a special technology of creating that employs computer graphs and image processing technology in the fields like art creation, graphic design, films and animation, etc. (Singh, G., 2015) In 1998, Han Ke and some others carried out a series of studies on modern art design based on computer technology (Lynch, P., 2016). And in 2000, Jiang Leihong and some others analyzed and researched the influence of computer painting on art design (Kim, H. K., Kim, K. M., & Nomura, S., 2016). In the same year, Cheng Nan and some others compared computer art design and traditional art design (Hutsell, M. K., 2015). In 2002, Niu Le and some others researched the development of computer art, graphic software, hardware technology as well as its aesthetic features (Holz, E. M., Botrel, L., & Kübler, A., 2015). In 2006, Wang Xiaoming and some others conducted an innovative research on computer art and

creating thought (Šuvaković, M., 2015). In 2011, Tang Xueying, Song Kaixue and some others made some applied studies with the use of some CorelDraw ways of producing thematic maps (Henle, M., 2015). Thanks to computer technology, we can maximize the efficiency and quality of art design and enhance the level of art design. (Gasca-Hurtado, G. P., Peña, A., Gómez-Álvarez, M. C., Plascencia-Osuna, Ó. A., & Calvo-Manzano, J. A., 2015) With the universal application of computer technology in all the fields, it also enters the field of art design. Computer technology can not only increase the level of art design, but also enrich its expressive ways. We can say that the present art design will be impossible without computer technology (Sharma, E., & Paul, S., 2015).

2. The Relation Between Traditional Art Technique and Computer Art Technique

Computer digital technology has changed the way of art teaching painting. The traditional art teaching sketching way has been substituted by computer automatic painting technology, producing a new painting technique and kind (Iwasako, K., & Soga, M., 2015; Balzarini, R., Dalmasso, A., & Murat, M., 2015).

At first, it is automatic drawing technology, namely, using computer automatic drawing technologies (like whirl line technology and diffusion technology) to create art paintings. Most computer software possess the function of automatic image processing, producing art painting works like watercolors and oil paintings (Marinangeli, L., Pompilio, L., Baliva, A., Billotta, S., Bonanno, G., Domeneghetti, M. C., ... & Pondrelli, M., 2015).



Figure 1 – The left is the Original Image, is Generated by Computer Automatic Drawing Technology is on the Right Side of Painting Style.



Figure 2 – The Left is the Original Image, the Right is to Use the Computer Automatic Technology Generated Watercolor Paintings.

Computer-aided art teaching changes the style of art teaching painting way. The style of the traditional art teaching sketching is single and has no change. Style of drawing is affected by conditions like the physical properties of the paper, paints, brushes and so on(as shown in figure 3).

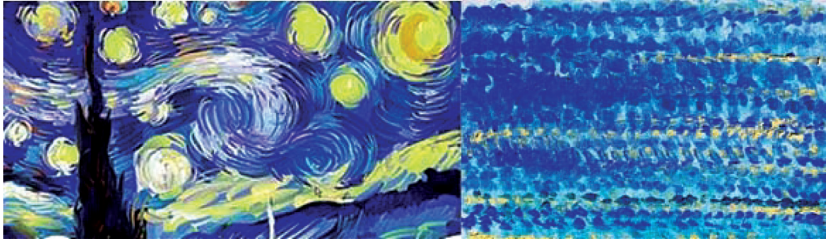


Figure 3 – Traditional Painting Style Oil Painting Brush.

However, the style of computer automatic painting is not affected by the above factors (as shown in figure 4).

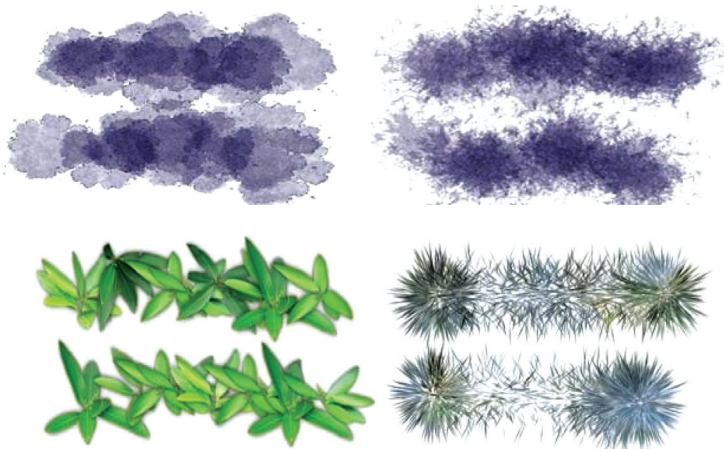


Figure 4 – Computer Automatic Drawing of Brush Strokes

Computer digital three-dimensional software technology is also a major part of computer-aided drawing, which can automatically producing drawing to replace the hand-made one, thus enriching the contents of art composition(as shown in figure 5 and 6) (Iwasako, K., & Soga, M., 2015).

Art composition drawing technology has altered the art composition thought, transferring the emphasis from perspective graph to standard drawing to spatial creation and simulation. The computer technologies concerned include Sketchup, 3DMAX, MAYA, AUTOCAD and so on. The database of digital network learning platform restores various sorts of model data, available for the learners to use in their projects and thus beneficial for the advance of their self-study quality; teachers offer user's guide of the software, assisting the learners in developing computer image processing ability as soon as possible, giving them more comments and guiding the creation activity of the projects.



Figure 5 – Traditional Drawing Art Artificial Composition Effect



Figure 6 – Computer Aided Drawing Art Composition Effect

Computer-aided art composition drawing technology complies with the development requirements of art teaching composition basic courses and forms a new pattern of digital art teaching (Haselberger, L., & Holzman, S., 2015).

3. Study on the Teaching Model of Computer-Aided Art

The characteristic of the courses based on computer-aided art teaching model is that they start from the actual teaching and employ the modern computer digital internet learning platform technology to realize the art teaching activity. In this process, many computer software technologies are used and concerned, containing: ASONET, SQLServer 2005, Macromedia Dreamweaver, MX, Photoshop, 3DMAX and so on (Shaari, N. L. A., Isa, I. S. M., & Hasnawi, S. A., 2015).

3.1. The Model Framework of Computer-Aided Art Teaching Model

The curriculum scheme of computer-aided art teaching is constructed on the basis of the model. This section elaborates the curriculum scheme based on computer-aided art

teaching with the focus on the research of the teaching scheme based on digital network learning platform. The curriculum framework of computer-aided art teaching mainly indicates the combination of fine arts with computer technology. Thanks to the help of computer technology, fine arts can better promote the development of aesthetics teaching; on the other hand, the support of fine arts for computer technology promotes the continuous emergence of new computer technologies.

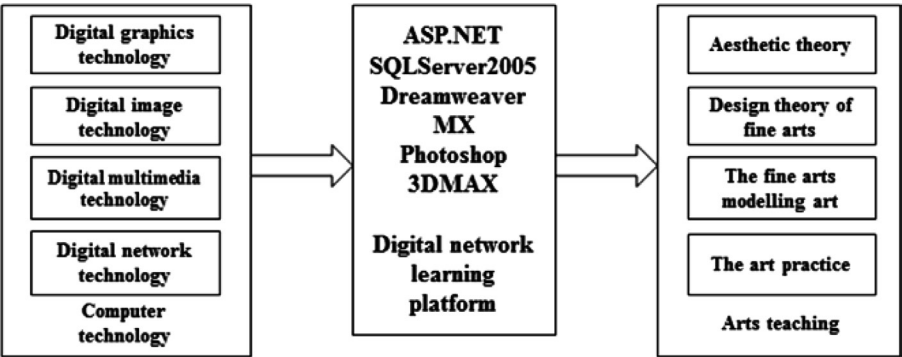


Figure 7 – Computer Aided Teaching of Fine Arts Curriculum Framework

3.2.Key Technologies of Computer-Aided Art Teaching Platform

The teaching platform of computer-aided art design is based on B/S model and takes Windows Server as the server, C# as the development language. As for its database, it uses SQL Server.

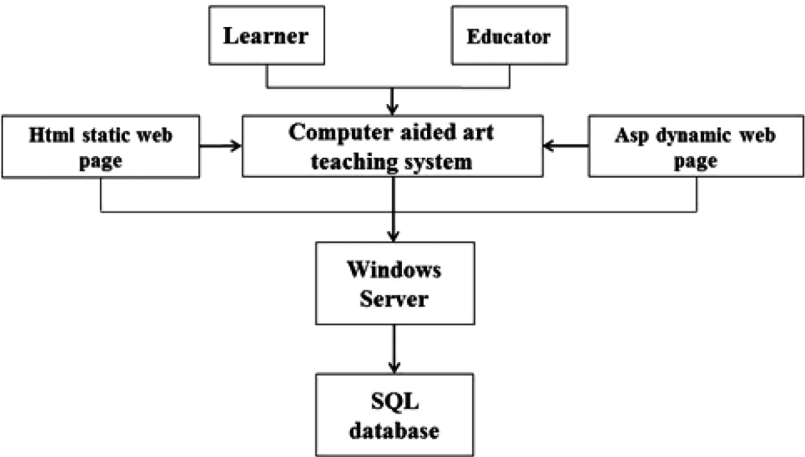


Figure 8 – The Scheme of Realization of Computer Aided Art Teaching Platform

1. Construction of SQL Server database

The teaching platform adopts SQL 2005 database to restore data materials. The system provides the educators with the functions like input, modification and deletion of data.

During the running process of the system, it will automatically withdraw data from the database for the learners' reference.

Field name	Field type	Length	Primary key	Allow
<i>UserName</i>	varchar	20	Y	N
<i>PassWord</i>	varchar	20	Y	N

Table 1 – Educators Login Information Table

Field name	Field type	Length	Primary key	Allow
<i>UserID</i>	varchar	20	Y	N
<i>UserName</i>	varchar	20	N	N
<i>UserPwd</i>	varchar	20	N	N
<i>UserPower</i>	int	4	N	N

Table 2 – Online Consulting Information Table

Field name	Field type	Length	Primary key	Allow
<i>PaperID</i>	int	4	Y	N
<i>CourseID</i>	int	4	N	N
<i>PaperName</i>	varchar	20	N	N
<i>PaperState</i>	bit	1	N	N

Table 3 – The Examination Paper Information

Field name	Field type	Length	Primary key	Allow
<i>ID</i>	int	4	Y	N
<i>PaperID</i>	int	4	N	N
<i>Type</i>	varchar	500	N	N
<i>TitleID</i>	int	4	N	N
<i>Mark</i>	int	4	N	N

Table 4 – Paper Details Information

2. Streaming media and dynamic Web page technology

In this system, streaming medium are used in large amount. At present, streaming media technologies used mainly include Windows Media Technology of Microsoft,

Quicktime Technology of Apple and Real Media technology of Real Networks. Since the Windows 2005 Server used in this system has incorporated the streaming media parts with relatively full tools and at the same time Windows operation system has integrated the explorer of streaming media, this system mainly uses Windows Media Technology of Microsoft during the process of manufacturing. The systematic proscenium employs JavaScript footnote language as well as CSS (Cascading Style Sheets) in large scale. JavaScript footnote language can achieve the purposes of fulfilling data examination at the client side, exchanging with users, displaying the system's time and beautifying web's visual effect. And CSS (Cascading Style Sheets) can control the fonts as well as image effect of the proscenium web page.

3. HITS algorithm web page searching technology

As the network learning platform concerns lots of websites as well as data connection, it is of great importance to use this kind of searching method. Considering the structure and function of the platform comprehensively, HITS (Hyperlink-Induced Topic Search) is adopted here.

HITS (Hyperlink-Induced Topic Search) algorithm makes use of Hub/Authority way and it is conducted as follows: submit the query contents q to the traditional searching engine based on key word matching, the engine then return many web pages, from which select n pages as the root set, represented by S , which meets the following three conditions:

1. The number of web pages in S is relatively small.
2. Most web pages in S are related to query q .
3. Web pages in S contain many authority ones.

By adding the web pages quoted by S as well as those quoting S into S , it will be expanded to be a larger set T . Set the Hub web page in T as the vertex V_1 and the authority web page as the vertex V_2 , and the hyperlink between V_1 and V_2 is the frontier set E . In this way, a bipartite digraph $SG=(V_1, V_2, E)$ is created. As for any vertex v in V_1 , use $h(v)$ to represent the Hub value in web page v . While as for the vertex u in V_2 , use $a(u)$ to represent the Authority value in the web page. At the beginning, $h(v)=a(u)=1$, conduct I operation on u to change its $a(u)$ and O operation on v to change its $h(v)$. Then standardize $a(u)$ and $h(v)$. Calculate the following operations I and O in such way repeated until $a(u)$ and $h(v)$ converge.

$$I \text{ operation: } a(v_o) = \sum_{v_o(v) < v} h(v)$$

$$O \text{ operation: } h(v) = \sum_{u(v) < u} a(u)$$

After each iteration, $a(u)$ and $h(v)$ should be standardized:

$$a(u) = a(u) / \sqrt{\sum_{q \in V_o} [a(q)]^2} \quad h(v) = h(v) / \sqrt{\sum_{q \in V_i} [h(q)]^2}$$

The above formula reflects that if a web page is directed by many Hubs, then its authority value will be increased accordingly (namely authority value will be increased to the sum of the present Hub values of the web pages directing it). Formula(2) reflects that if a web page points to many good authority pages, then Hub value will grow accordingly (namely Hub value will be increased to the sum of the authority values of all the web pages).

4. The Influence of Computer Technology on Art Development Trends

4.1. The Sprouting and Emerging of Computer Art as A Subject

The basic characteristics of a kind of art are developed during the process of its emergence as well as growth and differentiated from the other sorts of art. The trend of this kind of differentiation is actually the reflection of art division and also the inevitable outcome of people's continuously increasing spiritual needs. The basis of the differentiation lies in the natural difference between the materials of art signs and their existence forms. And it is the difference that determines their distinct structures as well as functions. Hence, every kind of art possess the expression objects, expression ways and aesthetic effects most suitable for them (Schroeder, D., & Keefe, D. F., 2016). The basic characteristics of computer art endow it with an eternal piece of area belonging to itself, in which it possesses the expression power that any other kind of art cannot replace. As a result, a colorful, harmonious and divers "digital" world of art is created.

4.2. Computer Technology's Requirements for the Future's Art Creation Subjects

Bill Gates once said: "Computers should be designed as if even dogs could use". In other words, computer should be a convenient and also practical tool for artists as well as designers. Indeed, the application of computer in the field of art has greatly enhanced their efficiency. Collected numerous art creating means, it provides larger space for the artists to realized their originality. The development of computer's art function also offer a quite convenient art platform for people's work and life. You can implement art design activities simply by sitting in front of the computer and starting a painting procedure with your mouse or even an extremely usual office word processing procedure, free from purchasing paints. Computer's art function makes it possible for nonprofessional art workers to enjoy art creation, appreciate art practice, and give play to their own art creating ability. Thanks to computer's fast speed and convenience, the technology level, which used to be achieved through longtime training, as well as the art skill, which used to be operated by professional personnel with basic art training, become common ones that people can use at will. This is a big step in art expression means brought by the advance of science and technology, which greatly brings forth people's art expression passion. However, there are several problems in this kind of passion, which also raises new demands for the qualities of the art creation subjects.

5. Conclusion

According to the decades of advance history of art based on computer technology, we can find that computer technology has had some profound influences on the aesthetic

thought, creation medium, expression models and so on of the subjects during the process of traditional art creating. Computer has become an extended painting brush for artists, facilitating the art design field. Computer technology is a bridge linking science and art, an inevitable trend for art development in the future. Under the influence of computer technology, the traditional appreciative art works and practical art works have been changed because of the intervention of computer technology. Their contents are superficial. And works paying attention only to forms are also produced. The nonrepeatability as well as uniqueness of traditional art works have been changed completely by computer technology. A new sort of computer art subject is having profound changes with the promotion of computer technology. Computer art, which is combined by computer technology and art, is an interdisciplinary subject, concerning other subjects like art, computer, maths, electronics and so on. Art faces the challenges from the other subjects in an open way. What's more, it transforms challenges and conflicts into exchanges and cooperation. It keeps expanding its own development space. Computer artists should own not only solid basic art foundation, but also the ability to use computer software and hardware. They should be able to use nInterpol, familiar with all the communicating manners of the information-based society. The contents of computer art have far surpasses itself. The fact that it can grow in such a short period and break through the boundaries among different subjects show that: the innovation of art can not only break the limitations of art type, but also develop more and break the limitations of different subjects. In today's information-based society, "communication" is a vital way of living and developing. No subject can stagnate and be conservative. Neither can art. "Computer is no longer related only to calculations. Instead, it determines our life." We are in such a time: a few years ago, people didn't know how a computer looked like. However, just a few years later, we have come to the period of "life cannot be without computers". Computer art creation pays attention to not only artists' mastery of techniques, but also their proficiency in using computer software and hardware as well as digital units. Artists should excel at enriching the raw materials of their creation with the aid of digital cameras and scanners. They should also learn the tools of each kind of software and know how they produce the art effect, as as to realize their ideas. In essence, this kind of adaptive process of computer is the same with that of pen, ink, paper and so on. Besides, during the creating process of computer art, the opportunity of the works' birth and the chances for us to see "them" are out of portion. In traditional art, a piece of work possesses uniqueness in forms no matter it is improvised or produced for a long time. The painters develop their subjective awareness based on study experiences, aesthetic restrictions and tool limitations. Nevertheless, computer art creating endows us with abundant selections, of colors in particular. Strange to the left or the right, the artist will have unremitting inspirations for various kinds of colors in the same frame. Therefore, the change of creating mindset will greatly intensify the function of art aesthetics. It is a new challenge for the creators with high efficiency to think of when to "stop" the work.

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On the Research of Force into Computer Database Intrusion Detection Technology

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Abstract: There are more and more governments, businesses, financial institutions connecting their own databases with the Internet. More online databases are attacked by hackers, leading to greater damage. Database security has become a major research field of information security. The detection technology which deals with external force intrusion into computer database has become the key research field recently. This article starts with the introduction of intrusion detection system and its functions and analyzes the commonly used computer intrusion detection technology mainly from the misuse detection and anomaly detection. According to the features of IDS and data mining technology, put forward a sort of IDS using data mining technology. This system consists of data acquisition, rule establishment, anomaly detection, and response handler. With the adoption of the improved Apriori algorithm, namely association rule data mining technology, abstracts specific behavior characteristics and rules according to related system data to construct database security abnormal or normal modes and analyzes in a quasi reality using both Misuse Detection and Anomaly Detection approaches. Finally it can be proved that support determination has a great influence on data mining result.

Keywords: Database; intrusion detection; Apriori algorithm.

1. Introduction

With the rapid development of the Internet, the computer networks have played a more and more important role in society, economy, culture, and people's daily life. Meanwhile, there are more and more governments, businesses, and financial institutions connecting their own databases with the Internet, leading to more and more frequent attacks to online databases and bigger and bigger losses. Therefore, database security has become the focus among all things. It is urgent that weresearch on the database intrusion detection technology to improve security. Many universities and research institutions in China have engaged themselves in the application research of data mining in intrusion detection. In terms of the technology system, Hu Huaping, who is from computer department of NUDT(National University of Defense Technology) put forward the system architecture and composition of large-scale network intrusion detection and pre-warning system, using data mining and data fusion technology. Song Shijie researched on network misuse intrusion detection system based on data mining, and analyzed and realized it from both

network and application. Hu Min and Pan Xuezheng, who are from Computer Science and Technology department of Zhejiang University, researched on real time intrusion detection technology based on data mining. (Deen, A. N. I. S. A. H., & Leonard, L. L. E. W. E. L. L. Y. N., 2015) Zou Shihong, who is from the State Key Laboratory of Networking and Switching of BUPT (Beijing University of Posts and Telecommunication) researched on adaptive intrusion detection system based on CIDF. Liu Tao, who is from Information Security Institute of Shanghai Jiao Tong University, put forward a distributed intrusion detection system based on data mining, which can detect distributed intrusion behavior and coordinated attacks. According to the features of intrusion detection system and data mining technology, this article puts forward a new intrusion detection system using data mining technology. (Adeleke, O. O., Makinde, V., Eruola, A. O., Dada, O. F., Ojo, A. O., & Aluko, T. J., 2015) This system consists of data acquisition, rule establishment, anomaly detection, and response handler. With the adoption of the improved apriori algorithm, namely association rule data mining technology, extracting related behavior characteristics and rules according to related system data to construct the abnormal or normal modes of database security (Plank-Bazinet, J. L., Kornstein, S. G., Clayton, J. A., McCaskill-Stevens, W., Wood, L., Cook, N., ... & Begg, L., 2016).

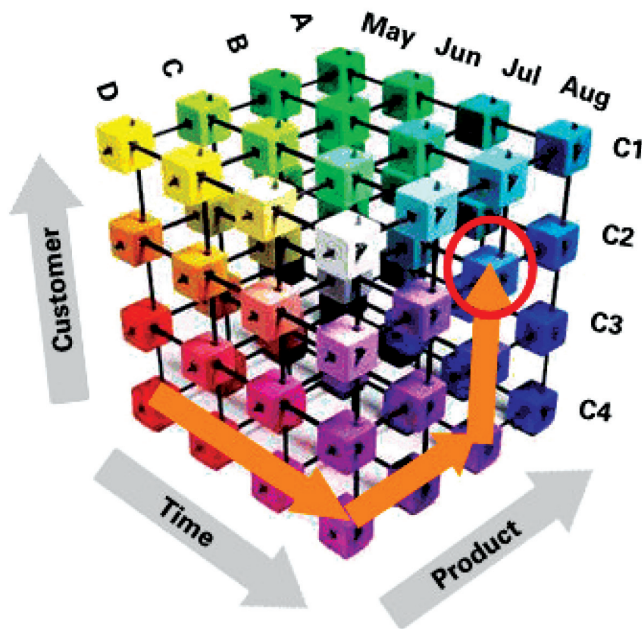


Figure 1 – Database Model

2. Intrusion Detection and Its Function

Intrusion detection refers to monitoring the computer database or network. If there are some abnormal behaviors in the process of the computer or some external bodies attempting to force into the database, monitors will automatically protect the computer database. (Galván, J. B., Recarte, L., & Pérez-Ilzarbe, M. J., 2014) Intrusion detection technology is an

active protection technology in the process of the computer and it is safer when compared with the firewalls. Many computer operations bypass the firewall, so the protection function of firewalls is not comprehensive. From the view of firewalls' characteristics, they mainly defend the outside violated operations and are not able to efficiently prevent the inside abnormal behaviors from happening. The most important thing is that firewall protection is a passive protection and cannot actively track violated behaviors (Dressler, V., 2015).

The main threats in front of computer databases are hackers and virus now. The losses that caused by hackers and virus attacks to computer database worldwide are enormous. Therefore, intrusion detection technology is very important. From the view of defense, the function of intrusion detection approach embodies as follows: First, the computer intrusion detection technology can be used mainly to examine weak links in the entire computer system. (Gonzalez, L. F., Montes, G. A., Puig, E., Johnson, S., Mengersen, K., & Gaston, K. J., 2016) Second, the computer intrusion detection technology can make real-time detection to all the operations of all computers. Third, the computer intrusion detection technology can deeply analyze all kinds of abnormal behaviors, so as to react accordingly. (Lee, J. Y., Yip, W. C., & Hu, Q., 2016) Fourth, the computer intrusion detection technology can record every abnormal behavior, which is the basis of the detection. And then it strengthens the security of computer (Ferris, M. E., Miles, J. A., & Seamon, M. L., 2016; McGowan, S. L., & Kern, A. L., 2016).

3. Common Intrusion Detection Approaches

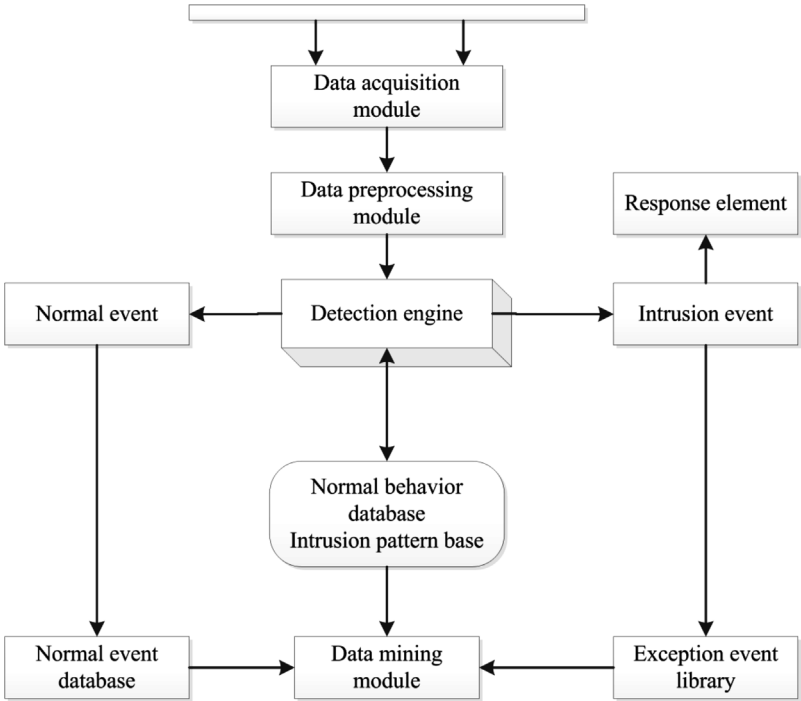


Figure 2 – Intrusion Detection System Mode

3.1. Misuse Detection Approach

Known viruses, attacks and intrusions are what Misuse Detection Approach mainly used to guard against. With this approach, some known intrusion behaviors and anomalous activities are analyzed first, and then characteristics are summarized to establish certain patterns which are used to be compared with anomalous activities that emerge on in-use computers, to find out whether there exist matching features between the two to identify illegal intrusion if so, (Deal, E., 2016; Tang, C., Lorenzi, N., Harle, C. A., Zhou, X., & Chen, Y., 2016) or not if not so. It could be easily conferred that Misuse Detection Approach can be only used in a comparatively limited way, because it can only be used to detect viruses or abnormal behaviors already known to us, while some unknown abnormal behavior cannot be detected. But in the era of rapid development of computer and network technology, in which various technologies are becoming more and more mature, and new types of computer viruses and attack behaviors are coming out every day, if Misuse Detection Approach is used on a computer, many illegal intrusion activities cannot be detected, thus composing great threats to the safety of the computer database. However, it has its own advantages for its comprehensive understanding of the characteristics of some viruses and so it has a relatively high accuracy in the detection of known viruses and intrusion behaviors (Arnold, M., Leitzmann, M., Freisling, H., Bray, F., Romieu, I., Renehan, A., & Soerjomataram, I., 2016).

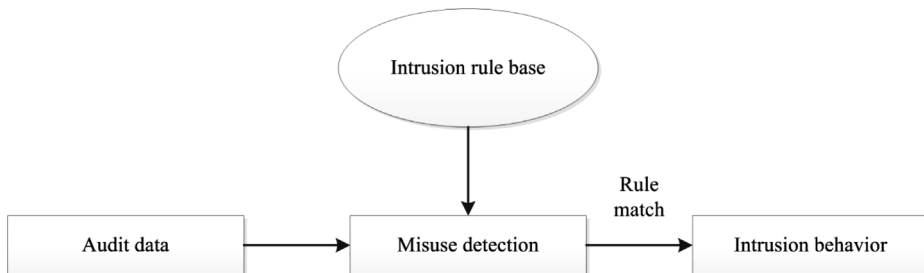


Figure 3 – Misuse Detection Model

3.2. Anomaly Detection Approach

Anomaly Detection Approach consists of the analysis of users' habit over a long-term computer use, and summarization of the characteristics of users' behaviors which are then stored in databases as models, and comparison between the characteristics of a running computer behaviors and those of daily user behaviors stored in databases by the system, to determine whether the differences between the two are obvious enough to identify an intrusion, so as to cause the computer to defend against it. Compared with Misuse Detection Approach, the Anomaly Detection Approach does not require any model; instead, it abstracts rules automatically in the process of the daily use of a computer, and employs user's activity rules drawn from operation behavior data to detect not only known viruses and attacks which Misuse Detection Approach can reach, but also the unknown intrusion behaviors with a relatively high accuracy, thus greatly strengthening the safety of computer database (Wahab, S., Razali, R., Ismail, A. K., Kamarudin, M. A., Mohd Tohit, N., Durai, R. P. R., ... & Siraj, H. H., 2015).

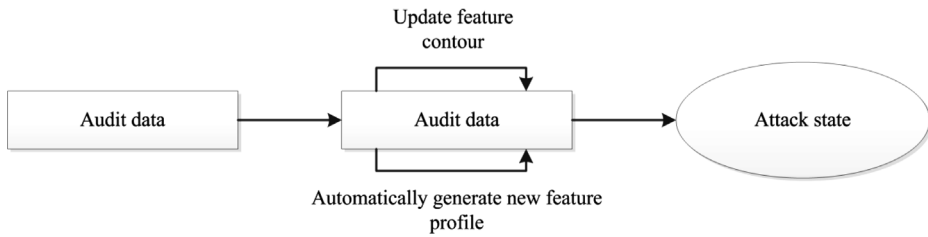


Figure 4 – Anomaly Detection Model

4. Improve Intrusion Detection Approach

Combining Misuse Detection and Anomaly Detection, a novel adaptive intrusion detection system is designed and implemented. An improved Apriori algorithm is applied to the new IDS in order to improve the performance of rule generation.

4.1. An Improvement on Apriori Algorithm

The core of Apriori algorithm is to search for the large item sets, which goes in two sub-processes: (1) to find the candidate set for level k - item set C_k based on the found $k-1$ level frequent item sets L_{k-1} (all possible level k frequent items sets constitutes a superset of a single level k frequent item sets); (2) to count up the support of each member item of candidate set for level k -item set C_k by scanning the database D , and to level k frequent item set L_k . Although Apriori can prune a great number of candidates, there still exist in a large scale transaction database huge amount of candidate sets to process which can be extremely time-consuming. For example, with Apriori algorithm a transaction database containing 10^6 items in which only 1% (i.e. 10^4) are frequent ones will generate more than 10^7 2-item candidate sets in order to count up their respective supports by scanning the whole database, and to get L_2 and then 3-item candidate sets.

What's more, this algorithm requires repeated database scanning to calculate supports of candidate sets, in order to generate a new candidate set of a 1 larger length, which is tedious enough, especially when there is a long queue of length additions. Apriori, as an algorithm that first generate candidate sets and then check their supports, will scan a database 100 times in order to find out frequency set $X = X_1, \dots, X_{100}$. It uses bottom-up and breadth-first search approach, and will enumerate all frequency set. When a transaction database is relatively sparse (such as market basket data), frequency set pattern obtained by this kind of data is usually short, and so Apriori and Apriori-similar algorithms can achieve good performance.

Two improved Apriori algorithms are proposed here, based on a overall consideration of the advantages and disadvantages of Apriori algorithm, related references that introducing large item set discovering algorithm improvements, and algorithm's time efficiency and storage space requirements:

Approach 1: Reduce the number of candidates in candidate item sets C_k . In Apriori algorithm, all item sets in generated C_{k-1} are compared with the support, and those smaller than the support will be pruned, producing L_{k-1} , and further producing C_k by linking among L_{k-1} and L_{k-1} elements. This improved Apriori first prunes L_{k-1} by counting

all the items in L_{k-1} , deleting item sets which have items that count less than $k-1$, thus reduce the number of $k-1$ item sets that will link to each other, and finally cut down the number of candidates in candidate item set C_k .

Approach 2: In order to improve Apriori algorithm with respect to transaction database scanning, encode all the items occurring in the records of transaction database, if one item exists in a transaction, then this item's corresponding code is set as "1", otherwise "0". While encoding the support of a given item can be counted up and then producing frequent 1-item set. Next, frequent 2-item sets can be generated by applying "AND" calculation on those different encoding, and then through finite times of iterations of encoding modification and simplification operation according to attributes of large item sets in Apriori algorithm, frequent item sets of this database complying with association rules can be finally determined.

4.2. System Model

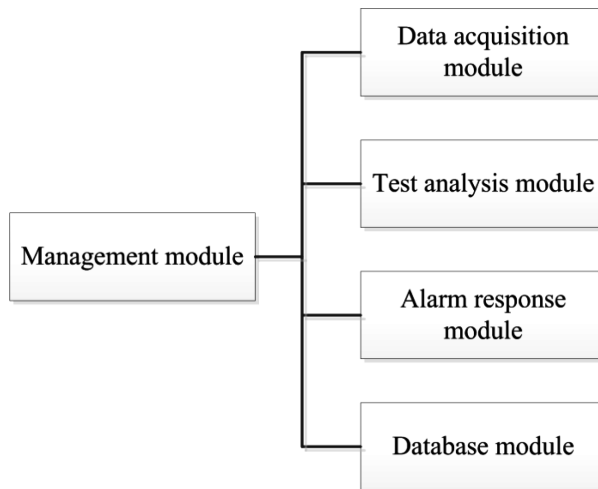


Figure 5 – Model of Database IDS

Intrusion detection system, detecting audit data, determines intrusion is happening and then makes an alarm. IDS can be divided into four parts from the perspective of function implementation: data acquisition module, detection analysis module, alarm response module, and database module. IDS can also be subdivided into five parts according to the implementation method: data acquisition module, detection module, response module, database module, and management module. The database intrusion detection system mentioned in this article can be used to detect anomaly in database. This system consists of five parts including database interface module, data acquisition, data processing, data mining and intrusion detection, which work separately during training and intrusion detection phase (Sucheran, R. E. S. H. M. A., 2015).

Data acquisition: in the training phase, database sever mainframe log file normal operation characteristics of historical data collection to prepare for constructing knowledge rule base; while in intrusion detection phase, the current server audit data are collected to prepare for intrusion detection.

Data pre-processing: integrating and processing the data collected, and prepare the data for the next step of data mining and feature extraction.

Data mining: using data mining techniques to extract behavior characteristics and rules from relevant data system, and then it can be used to establish the normal mode of database security.

Knowledge rule base: knowledge rule base stores the normal modes which the system needs. Database intrusion detection system will compare and judge between role behavior characteristics and the normal mode. If it does not conform to the normal mode, it can be called intrusion behavior; if not, It is normal behavior.

Feature extraction: adopt techniques similar to data mining to extract the behavior characteristics of the current role from its behavior data.

Intrusion detection: the intrusion detection system is based on intrusion detection algorithm, extracting related rule data from the knowledge rule base, and making intrusion detection of the current role behavior characteristics. The system can make responses to it according to the testing results. If it is the intrusion behavior, the system will make an alarm, and take some measures to prevent the invasion.

4.3. Knowledge Rule Base Construction

The excavation of intrusion characteristics is a very important topic, and the accuracy and range of the feature library directly affect the whole performance of the IDS. Correlation analysis is a technology of data mining. The association analysis is given a set of the Item and a collection of records that is derived by analyzing the record collection Item. In the database security system, correlation analysis can be used to find out the correlation between various intrusion behaviors of the invaders. The anomaly detection of the system mainly uses the associated mining method for data mining. It can be inferred from the above that the association rule mining algorithm can be divided into two steps. The first step is to find out all the frequent item sets in transaction database through iterative search. The problem of this step is after generating candidate frequent item sets each time, it needs to get back to scan the database to determine whether the candidate frequent item sets are real frequent item sets. This will cause repeated and large-scale of scanning of the database, and generate many space-wasting candidate item sets, which is both space-wasting and time-consumption. So the improved algorithm is proposed in sentences above. The second step in the association rules algorithm: association rules are generated by frequent item set. The rules are generated by the frequent item sets, so each rule is automatically meet the minimum support. Use a set of data to illustrate the generation process of association rules. Assume that frequent item set $l = \{I_1, I_2, I_5\}$. Association rules produced by l are given in the following. The non-empty sets of l are $\{I_1, I_2\}, \{I_1, I_5\}, \{I_2, I_5\}, \{I_1\}, \{I_2\}, \{I_5\}$. The following are association rules and its credibility acquired on the basis of it.

1. $I_1 \wedge I_2 \Rightarrow I_5 \text{confidence} = 2/4 = 50\%$
2. $I_1 \wedge I_5 \Rightarrow I_2 \text{confidence} = 2/2 = 100\%$
3. $I_2 \wedge I_5 \Rightarrow I_1 \text{confidence} = 2/2 = 100\%$
4. $I_1 \wedge I_2 \Rightarrow I_5 \text{confidence} = 2/6 = 33\%$
5. $I_2 \wedge I_1 \Rightarrow I_5 \text{confidence} = 2/7 = 29\%$
6. $I_5 \wedge I_1 \Rightarrow I_2 \text{confidence} = 2/2 = 100\%$

If the minimum confidence threshold value is 70%, then it only generates (2), (3) and (6) as a rule, which are left as the final output because their credibility is greater than the minimum confidence threshold value.

5. Experiment and Result Analysis

Experiment on simulationwarehouse management system for intrusion detection. The main users of the database are A, B, and C.

5.1. Misuse Detection

This misuse detection can mainly detect behaviors as follows: attack attempt, including password guessing, operation failure caused by unauthorized operation, illegal time login, user information discrepancy and so on; camouflage attack, login in through legal ways, but user behavior is different from usual one. Operation record failure appears and user permission has been changed abnormally.

Table 1 shows part of the misuse detection results.

Number	Intruder name	Invasion time	Detection time	Intrusion analysis
1	A	2015-11-23 09:12:53	2015-11-23 09:33:02	Users can log in for 3 times in a row in 1 minutes, and there may be an invasion attempt.
2	B	2015-11-23 11:42:37	2015-11-23 12:10:04	Users continuously in the 2 minute post operation failed, and there may be illegal operation
3	C	2015-11-23 14:29:11	2015-11-23 14:52:11	User permissions change operation, and there may be ultra vires
...	...	...	...	...

Table 1 – Result of Misuse Detection

5.2. Anomaly Detection Based on Data Mining

The rate of attack detection rate is higher for legitimate users through data mining method. Authorized users bypass the security mechanisms, usually login in databases which they don't at ordinary time, so their behavior patterns are very different from daily behavior pattern. Here are several factors affecting the rate of false positives: choice between the support and confidence, determination of time window and similarity, which all have a great influence on the performance of the anomaly detection.

The collection of user normal behavior history is 4007 records in this paper during the experiment. It firstly generates a new Table Base New-test, and the record is 35, thus greatly narrowing down database size to be scanned, and speeding up the production of association rules. This paper adopts the support of 10%, 20%, 30%, while the confidence becomes 85%, 95%, which shows association rules. As shown in table 2.

The determination of support has a great influence on the result of data mining, which can be seen from table 2. This paper adopts support of 10% and confidence of 85% in

Serial number	Support Level	Confidence level	Rule number	Explain
1	10	85	3923	Contains most user behavior
2	10	95	3421	Contains most user behavior
3	20	85	2642	Lack of user behavior
4	20	95	2319	Lack of user behavior
5	30	85	875	Lack of user behavior
6	30	95	782	Lack of user behavior

Table 2 – Influence of the Min_suP, Min_conf for Data Mining

the experiment to include most of the user behaviors, and then reduces the rate of false positives in the detection.

6. Conclusion

More and more governments, businesses, financial institutions connect their own databases with the Internet. Online databases are attacked by hackers more and more frequently, resulting in greater damage. So the network database security is the focus of attention. Although the large database offers audit techniques, it is difficult to find the intruder with artificial method from massive audit data because of its tremendous data. It is necessary to develop audit event analysis tool of database IDS (intrusion detection system). This article begins with the introduction of intrusion detection and its functions and analyzes the commonly used computer intrusion detection technology. According to the features of IDS and data mining technology, put forward a sort of IDS using data mining technology. This system consists of data acquisition, rule establishment, anomaly detection, and response handler. With the adoption of improved Apriori algorithm, namely association rule data mining technology, abstracting specific behavior characteristics and rules according to related system data to construct database security abnormal or normal modes and analyzing in a quasi reality using both Misuse Detection and Anomaly Detection approaches. Finally it can be proved that support determination has a great influence on data mining result.

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Research of Travel Information Service System Development Based on GIS Applications

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Abstract: With socio-economic development, tourism and leisure and other tertiary industries are developing rapidly and there is exponential growth in travelers in recent years bringing great difficulties to tourism management. In addition, in the travel process, the acquisition of travel information is lagging behind. The travel information service system based on GIS technologies is open to travel information, especially the public map service, which plays a significant role in obtaining electronic network maps. In this paper, a detailed analysis of GIS systems is made, and some development ways are presented. A structural design of GIS travel information system is put forward for the shortest travel path through the establishment of a geographic information. mathematical model. Finally, Dijkstra's algorithm is employed to choose the best path in GIS applications. In addition, the road traffic is seen as a vector diagram and the scans of urban road traffic go through vectorization treatment in MapInfo, a geographic information system software product. Afterwards nodes and border attributes are analyzed and the best travel path is eventually detected in the urban transport electronic map.

Keywords: GIS technologies; travel information service system; geographic information system; vectorization.

1. Introduction

In recent years, with the rapid development of the tourism industry in our country, a series of problems that exist in tourism management are highlighted. The guidance and management of information flow as a prerequisite that generates passenger flow and other tourist flows is clearly the key to solving these problems. The proposition and implementation of digital earth strategy has provided a way to address these issues, while global information highway constitutes the overall framework for the global information flow. In order to establish travel information systems that conform to the time requirements, we must resort to GIS technologies (Ciolfi, L., & Petrelli, D., 2015; Ellis, E., 2015; Weiler, B., & Black, R., 2015). Currently, the virtual Internet has been a reality to be confronted by the tourism industry, and how to integrate with the Internet is an inevitable problem for designing travel information systems. Faced with this situation, studying the rational structure, travel information characteristics and globalization of travel information systems has great practical importance. On January 31th, 1998, the former Vice President Al Gore of the United States (Frenzel, F., & Blakeman, S., 2015) delivered

a speech entitled *The Digital Earth: Understanding our planet in the 21st Century* at California Science Center, which first formalized the concept of digital earth. This concept has raised concerns about 3S (GIS, GPS, RS) technologies at home and abroad in various industries (Panda, J. P., 2015), while electronic maps which reflect 3S basic geographic information are to be significantly developed in many industries. The entire network electronic maps have been developing fascinatingly since Google successfully acquired U.S. Keyhole, Inc. in November 2004, opened Maps APIs web services and offered its digital mapping services for free. In two years from 2005, with the improvement of the technical level of digital maps, the digital map industry reveals explosive development. At present, representative two-dimensional digital maps in the country include mapbar.com developed by Beijing Mapbar Technology Co., Ltd. (Chan, A., Hsu, C. H., & Baum, T., 2015), 51ditu.com developed by Beijing Lingtu Software Co., Ltd., and Google's bendi.google.com that uses the U.S. satellite aerial technology. Domestic scholars Ding Longyuan, Chen Zhu, Luo Ping, Xiang Hua, *et al.* (Post, R., & Shanor, A., 2014) explored the development of component-based GIS software to be applied in travel information systems; their research mainly focuses on multimedia expression of travel information and multimedia technology and component GIS Integration, etc. There are also many cases that successfully employ component GIS to develop travel information systems.

2. GIS Systems

Geographic information system (GIS) is a computer software system that specializes in managing geographic information. It can not only manage a variety of information related to geographic locations according to different classifications, staging, or leveling, but also make various combinations, analyses, re-combinations and re-analysis, as well as carrying out operations such as querying, retrieval, modification, export and update. GIS also has a special visualization (Busetto, L., Luijkx, K. G., Elissen, A. M. J., & Vrijhoef, H. J. M., 2016) function: vividly reproduce all the information on maps or remote sensing photographs through the computer screen, to become information visualization tools and clearly and intuitively exhibit regularities and analysis results of information while also dynamically monitoring the changes of information on the screen. The basic expression forms of information are a variety of two-dimensional or three-dimensional electronic maps. The entire geographic information system consists of a computer, GIS software, spatial database, analytical application model, graphical user interface and system staff (Laureano, R., Caetano, N., & Cortez, P., 2014).

2.1. GIS System Composition

GIS consists of the following four systems, as shown in Figure 1.

Data input subsystem is primarily responsible for collecting and handling data from a variety of sources and transforming different types of spatial data.

Data storage and retrieval subsystem enables to organize spatial data through retrieval, updating and editing.

Data operation and analysis subsystem is the heart of GIS and works by using data such as data aggregation and dispersion, evaluation parameters and condition limitations and simulation analysis.

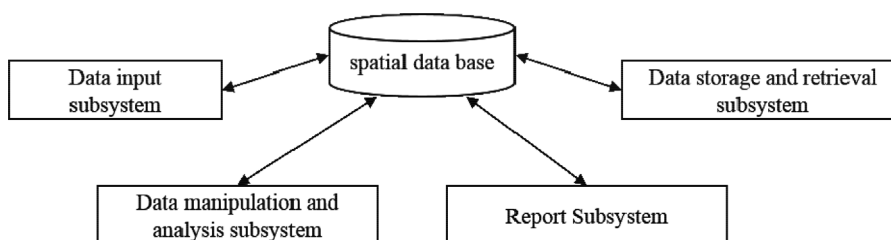


Figure 1 – The Component of GIS System

Reporting subsystem displays the output of all or part of the database in forms of tables, graphs, maps, and so on.

2.2. GIS Development Model

The application-type GIS development usually has three modes: independent development, simple secondary development and integrated secondary development.

(1) Independent development

Independent development is not dependent on any GIS software tools, from the collection and editing of spatial data to data processing and analysis and output of results. All algorithms are independently designed by developers and then some programs are used to design languages, such as Visual C++, Delphi, VJ++, etc., to realize programming in a certain operating system platform.

The advantages of this approach are the independence of people or commercial GIS software and reduction of development costs. Furthermore, because programmers can control all aspects of a program, various components of the system are the most closely related, have the highest integrated level and operational efficiency. However, due to the complexity, heavy workload and long development cycle of GIS, most developers are limited by their abilities, time and financial resources, so products they developed may be hardly paralleled to commercial GIS tools in terms of functions. Meanwhile, money saved in buying GIS software tools may not be worth the effort in the development process. This way is commonly used in early development of GIS, and it is rarely used to develop GIS at present.

(2) Simple secondary development

Simple secondary development refers to completely rely on secondary development languages offered by GIS to develop application systems (Occhi, K., 2015). Currently, commercial GIS software tools have been quite mature, most of which offer macro languages for secondary development, such as Avenue produced by Esri's ArcView and MapBasic in MapInfo Professional (Greenwald, D., & Constant, S., 2015). Users can use these macro languages to develop their own applications on the original GIS software platform targeting at different application objects.

(3) Integrated secondary development

Integrated secondary development means to use professional GIS tools such as ArcView and MapInfo to achieve the basic functions of GIS based on the development platforms

of common software development tools, especially visual development tools such as Delphi, Visual C++, Visual Basic, Power Builder, JBuilder and so on (Tumuheki, P. B., Zeelen, J., & Openjuru, G. L., 2016) for integrated development of both.

Integrated secondary development can be divided into two ways:

(1) OLE/DDE

OLE (Object Linking and Embedding) automation technology or DDE (Dynamic Data Exchange) technology is used and software development tool foreground is applied to execute the application while OLE automation or DDE is used to start GIS software tools for implementation in the background. The callback technology is used to dynamically obtain its return information and achieve the geographic information processing function in the application.

(2) GIS component.

GIS functional components are used based on OCX technology offered by GIS tool developers, such as ESRI's MapObjects, MapInfo's MapX etc. In the application prepared by the programming tool, the GIS function is embedded directly to achieve various functions of GIS.

3. Development of GIS-Based Travel Information Service System

World Wide Web (www) is based on the HTTP protocol, so any languages, scripts, and technologies that support the protocol can be directly used for developing WebGIS applications. At the software level, current methods for developing WebGIS include CGI (Common Gateway Interface), Plug-in application technology and Java programming technologies (Mohammed, E. A., Benson, S. D., Hirdaris, S. E., & Dow, R. S., 2016) encompassing Java Applet and Java Virtual Machine Technology (VRM); server application programming interfaces (ISAPI, NSAPI, ASP, IDC), Activex Controls and COM objects and the like. From a hardware perspective, it is mainly divided into servers and clients.

3.1. GIS Travel Information System Structural Design

Since the travel information system is a public-faced inquiry system, there are a large number of visitors. In order to improve browsing support and accelerate the transmission speed of network data, we select the ASP-based WebGIS (Ricijaš, N., Rihtarić, M. L., Borić, I. J., & Mirosavljević, A., 2016). The overall system configuration is shown in Figure 2.

The system is divided into multiple levels for management. Each level is in charge of different tasks and performs different operations. The front-end is responsible for data display and submission of tasks, while the back-end is distributed processed by multi-level servers.

As per the system design objective, the system will achieve the following features:

1. Dynamic data management capabilities

Maintain and manage system public data and users' personal data and provide online assistance to help users solve problems encountered in the use process at any time. The

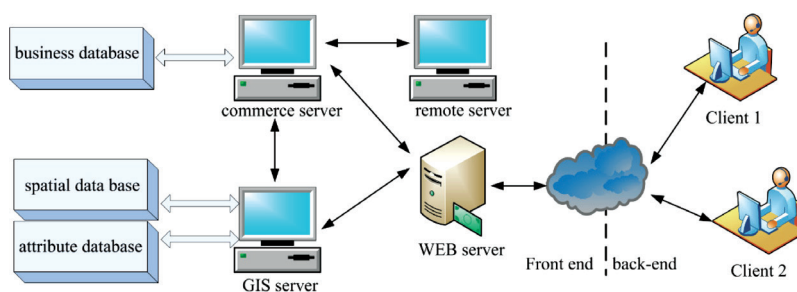


Figure 2 – The Structure of the Total System

system should be able to dynamically update the database regularly based on urban infrastructure and expansion and renovation of tourist attractions, to name just a few, and achieve its functions mainly in the business server.

2. Multimedia information display

Multimedia information like images, videos, audios, photos, maps, texts and other forms are used to comprehensively introduce the latest travel appearance of Wuhan, including picture presentation of Wuhan major attractions, guesthouses, hotels and entertainment venues; local customs and diet video presentations, among others.

3. Spatial data management and analysis functions

It is to mainly analyze and process data in spatial and attribute databases, complete the basic graphics processing operations and layer management functions such as zooming in and out, resetting and roaming of graphics, as well as finding the radius and seeking the best path and other spatial analysis functions. Meanwhile, the aerial view is provided so that users can keep abreast of the current zooming-in area in the whole map. Its functions are mainly realized on the GIS server.

4. The dynamic reporting capabilities of latest travel information

Including Wuhan recent weather reports, recently published travel regulations and preferential policies, Wuhan latest travel activities and routes and the like.

5. Scenic spots three-dimensional virtual display function

Use aerial remote sensing data, close-range photogrammetry data and TIN to construct a three-dimensional model for various scenic spots to show the characteristics of various scenic spots, encompassing visualization of three-dimensional landscape in scenic spots, any flight simulation in landscape and 3-D simulation of attractions, etc.

6. decision-making assisting functions

Database technologies are employed to acquire recent travel information. Through a series of professional decision-making models, travelers can have access to recent Wuhan travel information forecasts, travel route assessment, best travel arrangements and other decision-making information. Moreover, travel management departments can have access to travel sales prediction, guide scheduling of travel attractions in tourist rush seasons, planning of tourist attractions and other decision-making information.

3.2. GIS-Based Gallery Development

1. Basic gallery design

The electronic maps used in this system are vector diagrams and the main layer is shown in Table 1. Table 2 is the surface structure of the road network layer.

Layer name	Map form	Storage name
<i>Road network diagram</i>	Broken line form	
<i>Intersection chart (partly)</i>	Point form	
<i>Distribution map of scenic spots (partly)</i>	Point form	
<i>Hotel distribution map (partly)</i>	Point form	
<i>Distribution map of the market (partly)</i>	Point form	
<i>Tourist attractions map (partly)</i>	Point form	

Table 1 – The Layer of Map

The method of establishing a travel information map network associated with geographical coordinates is to vectorize roads and landscapes on the scans of MapXtreme travel maps, and build the corresponding database table, and x, y coordinates are programmed and assigned certain values.

Field	Explain	Type	Length	Key wods
<i>Raod_no</i>	Section number	char	6	primary key
<i>Road_name</i>	Section	char	20	
<i>S_point</i>	start node	char	6	foreign key
<i>E_point</i>	End node	char	6	foreign key
<i>S_x</i>	Starting X coordinates	float		
<i>S_t</i>	Starting Y coordinates	float		
<i>E_x</i>	Ending X coordinates	float		
<i>E_y</i>	Ending Y coordinates	float		
<i>len</i>	Section length	float		

Table 2 – The Structure of the Table

Attribute tables irrelevant to the graphics in this system such as train schedule, flight table and city buses table, etc. are presented in the database table structure.

4. Design of the GIS-Based Shortest Travel Path

Generally the shortest path algorithm is built on the abstract mathematical model, which is the network model. In this network model, the actual path is abstracted to be an edge of the network, and the length of the actual path may be disproportionate to the edge of the network. the edge weight characterizes the path length (or other characteristics). The method to find the shortest path from a point on the network to any other point is known as the shortest path algorithm.

4.1. Establishment of the Mathematical Model

In GIS, given the railway network that connects a number of cities (or road networks, below railway networks is taken as an example), find the best railway path between two given cities, and the mathematical model of this problem is as follows: take the city as the junction point and the railway line as the edge, construct an undirected graph G , $W(G)$ is the weight of the figure G . We require the subgraph H to meet certain conditions and make $\sum w(e) = \min$, where H is contained in G and has certain attributes. The above said best path in the railway is to find a path $P_0(\mu, \nu)$ between two given items μ and ν in the connected graph G , so that $W(P_0) = \min(W(P))$, $P \in T(\mu, \nu)$ where $W(P_0)$ is the distance between μ and ν and is denoted as $d(\mu, \nu)$. In addition, the weight of the edge in GIS is the product of the railway length between two cities and the attribute weight of the railway section. Therefore, first conduct model design and calculation of attribute weights in the railway section.

4.2. Model Design and Calculation of Railway Section Attribute Weights

The main part of this model is an algorithm. The model inputs various attributes in addition to length outside of the railway section, such as slope, driving limit, the number of trains, tonnage and other information; it outputs judgment regarding whether the data are reducible, data dependence and attribute weights. This is the famous AHP.

The specific algorithm:

1. Construct a judgment matrix A according to the railway section attributes:

Various attributes affect the railway to varying degrees, and we use the product of the influence intensity and the attribute value as an index to construct the judgment matrix A.

2. Detect the reducibility of A. If it is reducible, output reducibility information and exit.
3. Construct an auxiliary matrix $\tilde{A}$ as per the algorithm implementation needs, and we use the ordinary equivalent transformation skill to convert the judgment matrix A into the invertible auxiliary matrix $\tilde{A}$.
4. Compute the characteristic vector w and principal eigenvalue $\lambda_{\max}$.

Allow error ε and take any initial positive vector.

$$\bar{x}^{(0)} = (x_1^{(0)}, x_2^{(0)} \cdots x_n^{(0)})^T; \bar{y}^{(0)} = (y_1^{(0)}, y_2^{(0)} \cdots y_n^{(0)})^T = \frac{1}{m_0} \bar{x}^{(0)} \quad (1)$$

$$m_0 = \max_{1 \leq i \leq n} \{x_i^{(0)}\} \quad (2)$$

Iterative computation.

Let $K=0$, compute,

$$\bar{x}^{(K+1)} = \tilde{A} \bar{y}^{(K)} \quad (3)$$

$$M_{K+1} = \max \left(\bar{x}_i^{(K+1)} \right) \quad (4)$$

K=K+1 until,

$$|M_{K+1} - M_K| < \varepsilon \quad (5)$$

$$\lambda_{\max} = M_K \quad (6)$$

$$\bar{w} = \frac{\bar{y}^K}{\sum_{i=1}^m \bar{y}^{(K)}} \quad (7)$$

4.3. Algorithm Description of the Best Path

Cite Dijkstra's algorithm in accordance with the mathematical model established as well as the determination of weights that connect graph edges and the existing conditions (Rezaei, M. J., Sabahi, M. F., Shahtalebi, K., Mahin Zaeem, R., & Sadeghi, R., 2015). First construct the multi-dimensional matrix with the dimension of the total number of cities. Adjacent cities that are connected by an railway are assigned railway attribute values in the matrix while non-adjacent cities are assigned the value 2. Set the initial city index and end city indexes. Initial cities are taken as the object transformation matrix, so that the initial city can be placed in the initial matrix element. By referring to Dijkstra's algorithm, we calculate the shortest path and travel route from the initial city to the rest of cities (and cities that are successively passed through), and finally output them:

The mathematic description is as follows:

1. Let $l(\mu_0) = 0$; $\mu_0 \neq v$
2. $l(v) = \infty$, $S_0 = \{u_0\}$, $i = 0$
3. For every $v \in S_i$ (S_i is a subset composed of by sets in addition to S_i), replace $l(v)$ with $\min \{l(v), l(u_i) + w(u_i + v)\}$; set u_{i+1} s to make $l(w)$ take the minimum S_i , and let $S_{i+1} = S_i \cup \{u_{i+1}\}$.
4. (4) If $i = |V(G)| - 1$ stops;

If $i < |V(G)| - 1$, replace 1 with i+1, turn to (3).

This section makes some attempts on Dijkstra's algorithm in GIS, which has good applications effects in selecting the best path between two places in GIS.

According to the above characteristics of urban traffic network, we make the following assumptions:

1. (1) All sections (edges) are straight. For sections with great radians, for convenience of solving the angle between arcs so that the angle obtained can correctly reflect the relative positional relationship between the arcs, we can add a node to the section to reduce the radian. As shown in Figure 3, node 1, there is a great radian between nodes 1 and 2; add a node 3 on the section to divide the

original section into two sections with relatively small radians. That is to add a node in the network and divide one edge into two edges; each edge can be seen as a straight line to calculate the angle, but other attributes of edges (like length) is still characterized by arc attribute (such as curve length);

2. (2) Edges are bidirectional.
3. (3) Nodes are real nodes.

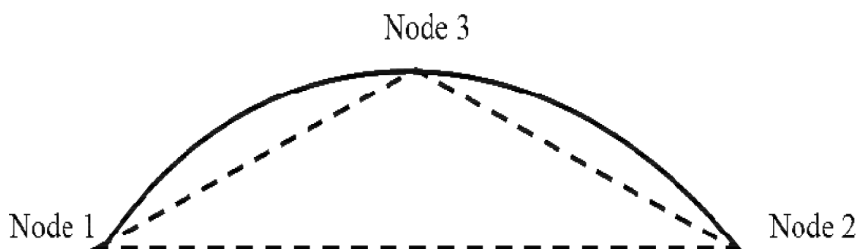


Figure 3 – More Nodes and Less Radian

The urban transportation network map is a vectorized urban road traffic map. In desktop GIS software MapInfo, the urban road traffic map scans go through vectorization treatment; nodes and edges of urban traffic network are extracted, which are the intersections and road sections in a map. Topology between network nodes and edges is defined by attribute field values of nodes and edges, namely intersection edge information in attribute field values of nodes as well as relative geographic coordinates (X, Y) of nodes; in the edge attribute field values there are start/finish node information and weights of the edges (like length). The assignments of these attribute values can be achieved by MapInfo programming MapBasic (de la Fuente, C. L., Sánchez-Cano, A., Segura, F., & Pinilla, I., 2016). Open the map window in MapInfo, and a clear urban transport electronic map is visible.

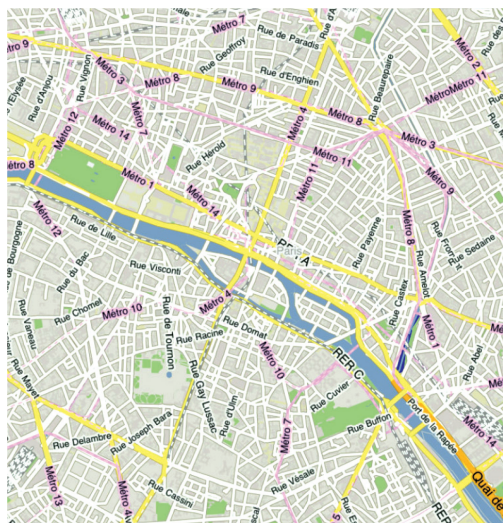


Figure 4 – The City Traffic Electronic Map Opened in Mapinfo

5. Conclusion

GIS as a special application field of travel information systems has provided an open information space for sharing travel resource information as well as a wealth of travel information for the majority of travelers. GIS has good prospects for development. In the near future, GIS technologies will continue to penetrate into all aspects of life, and people will be able to get more information and enjoy better services from the Internet. The GIS-based urban road network shortest path algorithm based on proposed in this paper is underpinned by the topological features of geographic correlation regarding network edges (sections) and nodes. The algorithm utilizes the principle that straight lines are the shortest; the solution process is simple, fast, and the shortest path length shares some similarities, thus providing some references for developing travel path information systems and exerting great significance.

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An Investigation of Constructing Electric Power Telecommunication Information System Based on Computer Information Technology

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Abstract: China's electric power industry is transforming from the development stage of national network, west-east power transmission, ultrahigh voltage and large generator units to a new stage featuring extra-high voltage, intelligent power, and green power generation. While improving power distribution reliability, China's power grid also has greater difficulty in operation control. Once a serious failure occurs that can lead to power outage in large-scale interconnected power grids, it would cause huge losses to the national economy and bring serious negative impacts to society. By introducing the definition and system architecture of wide area protection, this paper analyzes the wide-area needs to protect electric power telecommunication and discusses the research application status of computer technology in the electric power system as well as the research status of wide-area protection communication. In order to ensure the quality of various information services in integrated information transmission of electric power system, an improved worst-case fair weighted fair queuing plus (IWF2Q+) scheduling algorithm is presented, through which we can solve delays caused by WF2Q+ in integrated transmission of power communication system and avoid packet errors in the transmission of high-priority information services. Thus, simulation has verified the effectiveness of computer information technology in wide-area backup protection of electric power communication systems.

Keywords: Computer; information technology; power communication; informatization.

1. Introduction

With the development of electric power communication, a lot of electric power system businesses need to be transmitted through power communication networks. Thus power systems have growing dependence on communication networks, and electric power communication failures exert even more serious impacts on the power systems. Therefore, the power system production and operation department raises increasingly higher quality requirements for power communication networks, not only requiring power communication networks to be capable of providing adequate communications capabilities, but also requiring electric power communication networks to have high real-time, safety and reliability. Improving the quality of power communication networks and

increasing its reliability are not only dependent on the design phase of communication networks, but needs more to use computer technology to establish a set of systems for power communications informatization. He Kehang *et al.* studied theories and methods to deeply integrate information technologies and curricula in 2005 (Hsiao, J. L., & Chen, R. F., 2016); Liu Hongsheng, Ge Jun, *et al.* analyzed the applications of computer information technology in industrial production in 2008 (Doorasamy, M., 2015); Chen Xiangji *et al.* carried out a survey of the development of computer technology in 2007 (Payne, T. H., & Fridsma, D. B., 2016); Zhao Yang *et al.* briefly explored the optimization of power communication networks in 2010 (Kirby, Y. K., & Floyd, N. D., 2015); Zhang Jing *et al.* investigated the design of modern power communications management information systems in 2011 (Jakobson, L., & Manuel, R., 2016); Zhang Lincheng *et al.* discussed the changes and development of power communications in the new era in 2013 (Kumar, A., 2015), ultimately realized centralized monitoring and management of multi-disciplinary communications networks through the study, design and implementation of integrated management system of electric power communication networks, and provided an appropriate process management system combined with the needs to maintain and manage power company communication networks. Researching the construction schemes for urban electric power communication network systems has important theoretical and practical value for effectively improving the working level and efficiency of urban electric power communication networks, and enables computer technology to better serve electric power information systems (Kikot, T., Fernandes, S., & Costa, G., 2015).

2. Overview

During the Eleventh Five-Year Plan, China's power industry has achieved sustainable and rapid development. By the end of 2010 the annual national total electricity consumption had reached 4.1923 trillion kilowatts; new national infrastructure capacity had reached 91.27 million kilowatts; and installed electricity capacity had reached 960 million kilowatts; hydropower installed capacity had exceeded 200 million kilowatts; the installed capacity of nuclear power plants had exceeded 10 million kilowatts; the share of installed hydropower, nuclear power, wind power and other non-thermal power capacity had fetched 26.53%. With the rapid economic and social development of China during the Twelfth Five-Year period, electricity demand will continue to grow. It is expected that power consumption will reach 6.27 trillion kWh by 2015, with average annual growth of around 8.5%. It fully protects the power supply while actively developing green energy and optimizing energy structure has become a new development direction of the power industry (Tang, X., Luan, Z., Wu, N., Zhang, B., Jing, Y., Du, H., ... & Xu, S., 2015).

China's electric power industry is transforming from the development stage of national network, west-east power transmission, ultrahigh voltage and large generator units to a new stage featuring extra-high voltage, intelligent power, and green power generation. A nationwide electric power network composition has been initially formed in 2006 in the 500 kV, 330 kV, and 220 kV backbones. Inter-provincial and inter-regional power grids are interconnected through west-east power transmission projects in the south, middle and north of China. Nationwide interconnected grid has provided a foundation for cross-regional optimized allocation of energy resources to a greater degree, provided a guarantee to the growing electricity demand due to national economy and social

development, and heightened continuous improvements of people's living standards (do Valle Costa, O. L., & Figueiredo, D. Z., 2016).

Year	To achieve high reliability of power supply(%)	The average outage time
2014	99.91	6.722
2013	99.96	9.111
2012	99.92	12.071
2011	99.93	10.643
2010	98.32	13.192

Table 1 – The National City Power Supply System User Power Supply Reliability Index

Currently, traditional relaying protection and security and stability control are still important technologies to ensure safe and stable operations of the power system. With the continuous expansion of the interconnected power grid, the above problems not only make traditional relay protection equipment and security and stability control systems become threats to stability and security of power systems, but will also restrict the development of interconnected power grids. With the continuous development of computer technology and communication technology, it has been possible to obtain running state of each element of power systems at large spatial and small time scales (Eberle, L. S., 2015). Introducing power system wide-area information to the control criteria of relay protection and security and stability control has become the future direction of developing technologies in power system automation. Because the new relay protection principle and security and stability control strategy based on wide-area information of power systems can real-time inform running state of interconnected grids, the coordination between relay protection and security and stability control system can be realized by information exchange between systems and devices. Therefore, it is thought as being able to avoid traditional relay protection and security and stability control problems, to protect secure, stable and reliable running of large-scale interconnected grids, and to avoid large-scale grid collapses from happening. In fact, domestic and foreign experts and scholars in the power field have begun to research and develop a wide-area protection system based on modern communication technology, synchronized wide-area measurements and on-line dynamic security assessment technology (Pilorz, W., 2015).

3. Study of Integrated Transmission Algorithm for Power Communication Systems under Computer Technology

Realizing integrated information transmission of power communication systems entails solving traffic conflicts in integrated transmission of a variety of information services, ensuring quality of information services and particularly quality of real-time information services and taking into account quality of various non-real-time information services. This paper proposes to employ the differentiated services architectural model in internet protocol quality of service (IP QoS) to solve the service quality problems in integrated information transmission of power communications systems. Since it is based on common computer technology, it has broad application prospects. The IP-based network communications model lays a foundation for building a smart grid with unified information systems in the future (BENAMMAR, S. K., 2015).

The queue scheduling algorithm is one of the key technologies to realize network communications model based on IP technology and differentiated services architectural model, and plays an important role in solving service quality issues in integrated transmission of power system information.

This paper introduces the WF²Q+ algorithm in power system information integrated transmission, and points out that WF²Q+ algorithm delays transmission of high-priority information services packets, and solve the problem through introducing “virtual delay time” to the WF²Q+ algorithm, thus presenting the improved algorithm IWF²Q+ based on WF²Q+. In addition, the differentiated services architectural model grounded upon on IWF²Q+ is advocated to achieve power system information integrated transmission, thus guaranteeing better transmission quality for high-priority information services compared to WFQ and WF²Q+ algorithms while at the same time taking into account fairness among various types of information (Ojo, K. S., Njah, A. N., & Olusola, O. I., 2015).

3.1. WF²Q+ Scheduling Algorithm

WF²Q+ algorithm is a packet fair queuing (PFQ) scheduling algorithm based on the GPS model. It defines the virtual time $V(t)$ closest to the GPS model. The WF²Q+ algorithm changes the virtual start time S_i and planning finish time F_i from packet-based to session-based.

$$V(t + \tau) = \max \left\{ V(t) + \tau, \min \left(S_i^{h_i(t)} \right) \right\} \quad (1)$$

where $V(t)$ is the system virtual time corresponding to time t ; $v(t + \tau)$ is the system virtual time in an update time interval τ ; $h_i(t)$ is the sequence number of the packet at the head of the session i ; $S_i^{h_i(t)}$ is the virtual start time of session i of the packet $h_i(t)$; $i = 1, 2, \dots, n$ is the sequence number of the session; $A(t) = \{i | Q_i(t^-) \neq 0\}$ is the set of sessions backlogged in the server at time t and $Q_i(t^-)$ is the queue size of session i before time t .

$$S_i = \begin{cases} F_i & \text{if} \\ \max \{ F_i, V(a_i^k) \} & \text{if} \end{cases} \quad (2)$$

where S_i and F_i are also the virtual start and finish times of the session i ; a_i^k is the k -th packet p_i^k at the head of the session queue i , representing the system virtual time corresponding to $<$ time; $Q(a_i^k -)$ is the queue size of session i before time a_k .

$$F_i = S_i + \frac{L_i^k}{r_i} \quad (3)$$

where L_i^k is the length of k -th packet in section i ; r_i is the session service speed. In the differentiated services architectural model, the virtual start and finish times in the WF²Q+ algorithm are defined as queue-based, and the WF²Q+ algorithm scheduling queue is as follows:

(1) The initial state: All virtual start and finish times S_i and F_i in the queue of the system virtual time $V(t)$ are set to 0.

(2) The busy state: Let p_i^t be a packet that arrives the queue/head at time t . When p_i^t reaches the head packet of queue i , use Formula (2-2) to calculate queue/ virtual start time S_i , and use Formula 3 to calculate the virtual finish time F_i of queue i . Then the system looks for the queue that has the minimum virtual start time S_i among all non-empty queues; let the minimum service time of the system equal to the virtual start time $S_{\min}$ of the queue. The scheduler schedules each queue in an ascending order based on the virtual finish time F_i of the queue; the virtual finish time is minimum and the virtual start time S_i is not greater than the system virtual time queues to receive services. When the packet leaves the scheduler, the system updates the virtual start/finish times S_i and F_i of the queue, and then re-calculate the minimum service time $S_{\min}$ and use Formula 1 to calculate the system virtual time (Pinazza, M., Borga, C., Agnusdei, V., Minuzzo, S., Fossati, G., Paganin, M., ... & te Kronnie, G., 2016).

3.2. WF²Q+ Algorithm Analysis

The WF²Q+ algorithm assumes that the packets in multiple queues of the system arrive simultaneously at the head of the queues, and Q_i , $i=1, 2, 3, 4$ packets arrive simultaneously at the head of the queue. In this case according to the packet service order in each queue obtained by the GPS model, the packet service order of WF²Q+ in ideal cases would be the weight ratio of four queues in the differentiated services architectural model has priority differentiation in the queue system, so this paper defines that a queue with a small sequence has a high priority. In actual information service transmissions, each packet would not arrive at each head of the queue absolutely at the same time, and there will be minor differences, which will also result in minor differences in the packet service order at the head of each queue acquired by the GPS model (Deal, E., 2016). As long as packets in lower-priority queues arrive a little earlier at the head of the queues than packets in higher-priority queues, the WF²Q+ scheduler will first provide services to packets in lower-priority queues. Packets in higher-priority queues can receive services only after packets in lower-priority queues finish transmission and the scheduler enters into the next scheduling cycle and once again chooses packets to receive services. It can be found that the first packet at the lowest-priority queue receives services after the transmission of the first packet at the highest-priority queue, while the first packet at the head of the second-priority queue receives scheduling services after the first packet at the head of the third-priority queue receives services (Sproles, C., & Detmering, R., 2016).

In the power system, high-priority information services are generally applications that have high requirements for packet delays. For instance, wide-area relay protection, security control system, wide-area measurement system and SCADA have very strict requirements for packet delays, etc. If the WF²Q+-based differentiated services architectural model is applied to realize integrated transmission of high-priority information services and other information services in IP networks, then tackling aforementioned problems in WF²Q+ algorithm will conduce to reducing packet delays of high-priority information services in power system information integrated transmission.

3.3. Improved WF²Q+ Algorithm—IWF²Q+

(1) Principle of the improved algorithm

The PQ scheduling algorithm can be employed to ensure real time of high-priority information service packets in power system information integrated transmission. In the PQ-based scheduling algorithms in the differentiated services architectural model, packets from highest-priority non-empty queues first receive service; in accordance with the priority order, only when the high-level priority queues are empty can packets in low-level priority queues receive service, and so on. Thus, packets from the highest-priority queues can get minimum delays, and therefore PQ algorithm does not have high-priority packet transmission delays. The disadvantages of such a scheduling algorithm are also apparent; when packets from higher-priority queues always arrive, packets from lower-priority queues would have been unable to obtain the scheduling service, and the fairness of information services cannot be guaranteed.

In order to solve transmission delays of high-priority packets, this paper puts forward to define twice the time required for transmitting $i-1$ packets in highest-priority queues as the queue/“virtual delay time”, and its form is defined as Formula 4, where $n = 1, 2, \dots, n$ indicates that the sequence number of the queue, meaning to control the size of “virtual delay time”, and its value takes 0.1 in the paper.

$$D_i = \lambda \frac{(i-1)L_1'}{r_1} \quad (4)$$

Introduce A to Formulas (2) and (3) and the new virtual start time S_i' can be obtained. The computation formula with the virtual finish time is shown in Formulas (5) and (6).

$$S_i' = \begin{cases} F_i' + D_i & \text{if} \\ \max\{F_i', V(a_i^k)\} + D_i & \text{if} \end{cases} \quad (5)$$

$$F_i' = S_i' + \frac{L_i^k}{r_i} + D_i \quad (6)$$

(2) IWF²Q+ algorithm realization mechanism

Consider any two queues Q_i and Q_j in the scheduler, set $i < j$, which is that Q_i has higher priority than Q_j and they always have packets that arrive. Hence, only consider $Q_i(t^-) \neq 0$. Let the virtual start/finish times be S_i and F_i in the WF²Q+ algorithm, the virtual start time of Q_j is S_j and its virtual finish time is F_j .

In integrated transmission of power system information, when a variety of information service packets with different priority levels arrive at the header of each router queue at not necessarily the same time, and information service packets with higher priority levels arrive later than those with lower priority levels in an time interval δ_F , Formulas (2-7)

and (2-8) are established. δ_F is the arrival time difference between information service packets with higher priority levels and those with lower priority levels, and $\delta_F > 0$.

$$F_i - F_j = \delta F \quad (7)$$

$$F'_i - F'_j = \delta F \quad (8)$$

In the WF²Q+ algorithm, it can be obtained by combining Formulas (2) and 7 that:

$$S_i - S_j = \delta F \quad (9)$$

Virtual finish time updates, and it can be obtained by combining Formulas (3) and (9) that:

$$F_i - F_j = \delta F + \left(\frac{L'_i}{r_i} - \frac{L'_j}{r_j} \right) \quad (10)$$

As per SEFF (smallest eligible virtual finish time first) packet selection strategy, in the condition that F'_i and F'_j are feasible finish times, when

$$\delta F + \left(\frac{L'_i}{r_i} - \frac{L'_j}{r_j} \right) \leq 0 \quad (11)$$

the packet at the head of Q_i will receive services earlier than the packet at the head of Q_j .

In the IWF²Q+ algorithm, it can be obtained by combining Formulas (5) and (8) that:

$$S'_i - S'_j = \delta F + (D_i - D_j) \quad (12)$$

Virtual finish time updates, and it can be obtained by combining Formulas (5) and (12) that:

$$F'_i - F'_j = F + \left(\frac{L'_i}{r_i} - \frac{L'_j}{r_j} \right) + (D_i - D_j) \quad (13)$$

As per the SEFF packet selection strategy, in the condition that F'_i and F'_j are feasible finish times, when

$$\delta F + \left(\frac{L'_i}{r_i} - \frac{L'_j}{r_j} \right) + (D_i - D_j) \leq 0 \quad (14)$$

the packet at the head of Q_i will receive services earlier than the packet at the head of Q_j . In accordance with Formula (4):

$$D_i - D_j = \lambda \frac{(i-1)L'_i}{r_i} - \lambda \frac{(j-1)L'_j}{r_j} < 0 \quad (15)$$

Therefore,

$$\delta F + \left(\frac{L'_i}{r_i} - \frac{L'_j}{r_j} \right) > \delta F + \left(\frac{L'_i}{r_i} - \frac{L'_j}{r_j} \right) + (D_i - D_j) \quad (16)$$

When $\delta F + \left(\frac{L'_i}{r_i} - \frac{L'_j}{r_j} \right) \leq 0$, $\delta F + \left(\frac{L'_i}{r_i} - \frac{L'_j}{r_j} \right) + (D_i - D_j) \leq 0$, which is that the WF²Q+

algorithm satisfies that packets at the head of Q_i receive service earlier than packets at the head of Q_j . The IWF²Q+ algorithm also satisfies that packets at the head of Q_i

receive service earlier than packets at the head of Q_j . When $\delta F + \left(\frac{L'_i}{r_i} - \frac{L'_j}{r_j} \right) + (D_i - D_j) \leq 0$,

$\delta F + \left(\frac{L'_i}{r_i} - \frac{L'_j}{r_j} \right) \leq -(D_i - D_j)$, where $0 < \delta F + \left(\frac{L'_i}{r_i} - \frac{L'_j}{r_j} \right) \leq -(D_i - D_j)$. That is to say, the

IWF²Q+ algorithm satisfies that packets at the head of Q_i receive service earlier than packets at the head of Q_j , while the WF²Q+ algorithm doesn't satisfy that packets at the head of Q_i receive service earlier than packets at the head of Q_j . As thus, when a variety of information service packets with different priority levels arrive at the header of each router queue at not necessarily the same time, and information service packets with higher priority levels arrive a little later than those with lower priority levels, compared to the WF²Q+ algorithm, IWF²Q+ can transmit information service packets with higher priority levels in some cases, which has to some extent ensured the real-time property.

4. Simulation Models for Integrated Transmission Networks of the Power Communications Systems

The communications network topology designed by the IEEE 14 bus system is used in power system wide-area communication network for simulation analysis of queue scheduling algorithms. In the IEEE 14-bus system, buses 4, 7, 8 and 9, and buses 5 and 6 are respectively connected via a transformer. Since the buses connected via the same transformer is in the same substation, buses 4, 7, 8 and 9 are in the substation 4, while buses 5 and 6 are in the substation 5, other buses are in separate substations, so the IEEE 14 bus system has 10 substations. The communications link between substations in the power system generally lays in parallel with the power transmission lines, so it is assumed that there is a communications link between substations connecting with the power transmission lines in the IEEE 14 bus system, then wide-area communication network

topology is similar to the grid topology. Wide-area communications network nodes are configured to distinguish service network core routers. Substation 5 as the control center station exchanges information with other substations. There is a connection diagram between interior data source equipment in each substation and between information service servers in the control center station. Data source equipment and information service servers have access to wide-area communication network through differentiated services network edge routers. Edge routers and wide-area network core routers C_i in the substation are configured with 1 queue scheduler and 4 packet queues; the queue is represented by Q_i , $i=1, 2, 3, 4$. i is the sequence number of queues. The greater i is, the lower the corresponding queue priority.

Each substation internal data sources have considered four categories of information services, which are WAhdS, SCADA, fault information and management information. The control center is configured with servers corresponding to the data source to receive packet data generated by the data sources.

Data traffic configuration generated by various types of information services take into account the condition of grid failure, where the WAMS data traffic is 200kbit/s, SCADA data traffic is 500kbit/s, fault information and management information services data traffics are 800kbit/s. Information service priorities in a descending order are: WAMS has a priority of 4; SCADA has a priority of 3; fault information has a priority of 2 and management information has a priority of 1. Packets of various types of information services enter the queues Q_1 , Q_2 , Q_3 and Q_4 after reaching the routers.

Link	Length/h	Time delay/ms	Link	Length/h	Time delay/ms
C1-C2	30.6	0.15	C5-C7	102.87	0.71
C2-C3	102.39	0.71	C5-C8	132.31	0.95
C2-C4	91.19	0.66	C5-C9	67.38	0.44
C1-C5	115.23	0.78	C4-C10	139.82	0.99
C2-C5	89.46	0.65	C6-C7	99.35	0.7
C3-C4	88.81	0.64	C8-C9	103.21	0.71
C4-C5	21.78	0.11	C9-C10	180.22	1.31
C4-C6	43.71	0.32			

Table 2 – The Propagation Delay of Network Link

The packet fair queuing scheduling algorithm will assign network bandwidths in accordance with the pre-assigned weight values for information services forwarded by routers. Since all kinds of information services have different data traffic and priority levels, two factors should also be considered when assigning weights for various integrated transmitted information services. This paper uses two indicators--data traffic and priority of information services--as decision criteria and uses the analytic hierarchy process (AHP) to calculate weights of each information services, and will use the queue weight values in a packet fair queuing scheduling algorithm network router for configuration, which are shown $W_{Q_1}=0.1413$, $W_{Q_2}=0.2317$, $W_{Q_3}=0.3222$ and $W_{Q_4}=0.3048$.

5. Simulation Analysis of Computer Technology Fairness

To verify whether the IWPQ+ algorithm can reduce high-priority information packet delays in power systems while at the same time taking into account fairness between various types of information services, a simulation analysis is performed to compare the average service rates of 4 classes of information services transmitted between substations and control center stations by using the PQ algorithm, WF²Q+ algorithm and IWF²Q+ algorithm when power failure occurs.

The figure below shows the average service rate variation curves of 4 categories of information services in the edge router E5 by using the PQ algorithm, WF²Q+ algorithm and IWF²Q+ algorithm, where WAMS and SCADA service packets obtain substantially the same service rates under three kinds of algorithms, indicating that the differentiated services architectural model based on the PQ algorithm, WF²Q+ algorithm and IWF²Q+ algorithm has ensured the service rate of high-priority information services. Failure information packet has a higher service rate under the PQ algorithm than the WF²Q+ and IWF²Q+ algorithms. Management information packet has a higher service rate under the WF²Q+ and IWF²Q+ algorithms than the PQ algorithm. Fault information and management information packet have substantially the same service rates under the WF²Q+ and IWF²Q+ algorithms. The results indicate that the differentiated services architectural model based upon the WF²Q+ and IWF²Q+ algorithms can well coordinate service rates obtained by information services with diverse priority levels, which has ensured that high-priority information services gain sufficient service rate while also providing fair and comparable services to low-priority services.

The simulation was repeated 10 times by employing each algorithm, and the average service rates for four classes of information service packets are generated by randomly using PQ, WF²Q+ and IWF²Q+ algorithms. In addition, the interval estimation method is used to obtain the packet average service rate at the confidence of 0.95, and the computational results are shown in Table 3.

Service rate/ kbps	PQ		WF ² Q+		IWF ² Q+	
	Average	Confidence interval	Average	Confidence interval	Average	Confidence interval
WAMS	1788.7	1788.70±0.56	1785.11	1785.11±0.51	1785.33	1785.33±0.34
SCADA	4465.13	4465.13±1.51	4458.82	4458.82±2.41	2268.26	4468.26±0.53
Fault information	7021.76	7021.76±23.30	6213.29	6212.29±31.40	6388.16	6338.16±0.58
Management information	5030.89	5030.89±23.85	5849.64	5849.64±33.70	5715.12	5715.12±0.74

Table 3 – Get the Average Service Rate

By improving the WF²Q+ algorithm, this chapter obtains a new queue scheduling algorithm IWF²Q+ and proposes the IWF²Q+-based differentiated services architectural model to achieve power system information integrated transmission. The IWF²Q+ algorithm has solved the WF²Q+ problem that delays transmitting high-priority information service packets, has guaranteed delay boundaries and worst-case fair

weighted fair queuing of WF²Q+, and is equally complex as WF²Q+. The simulation results of the information integrated transmission network simulation model based on the IEEE 14 bus system suggest that the IWF²Q+ algorithm can provide lower packet delay than the WFQ algorithm and WF²Q+ algorithms while also taking into account fairness between various information services for integrated transmission.

6. Conclusion

With support from computer technology, the reliability of power supply has been improved, as well as the difficulty of network grid control and running. Wide-area protection has attracted considerable attention and been widely researched as it can avoid problems existing in traditional relay protection and security and stability control, protect the secure, stable and reliable running of large-scale interconnected grid, and avoid collapse of electric power communication systems. In this paper, the IWF²Q+ scheduling algorithm and the IWF²Q+-based differentiated services architectural model are brought about to achieve power system information integrated transmission. The IWF²Q+ algorithm has solved the WF²Q+ problem that delays transmitting high-priority information service packets, has guaranteed delay boundaries and worst-case fair weighted fair queuing of WF²Q+, and is less complex than WFQ. Further, the simulation results of the information integrated transmission network simulation model based on the IEEE 14 bus system suggest that the IWF²Q+ algorithm is able to provide lower packet delay than the WFQ algorithm and WF²Q+ algorithms while also taking into account fairness between various information services for integrated transmission.

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Research on the Applications of Computer VR (Virtual Reality) Technology in Physical Training

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Abstract: As one of the research hotspots of research institutes in and abroad in recent years, VR (Virtual Reality) combines multiple subjects as computer graphics technology, multi-media technology, sensor technology, 3-D vision technology, human engineering, artificial intelligence, pattern recognition and computer simulation technology, and simulates real or virtual environments in computer. This paper analyzes the features and functions of VR technology, studies the technical advantages and framework design, and combines with physical training of colleges and universities, aiming to create and experience the virtual world with computer hardware and software resources, realize the dynamic simulation of the real world, make real-time responses on users' gesture or language orders based on the created dynamic environment, and establish a real-time interactive relationship between the users and the simulative environment. The analysis of the application of VR technology shows that VR application in competitive sports field has a great significance in improving the training effect of the athletes, preventing accidental casualties and guiding athletes to complete difficult movements.

Keywords: Computer; VR (Virtual Reality) technology; physical training.

1. Introduction

As a new born technology, computer VR technology has been widely used and played an important role in various fields. With the development and progress of the times, VR technology is being applied to various domains. As sports field has been infiltrated and integrated with other subjects, VR technology also has a wide application perspective in sports games (Class, M., 2015).

With advancement of technology, to conduct scientific training with technological means has been an indispensable method to fully tap the potential of the athletes and an important method and way for them to make preferable achievements. At present,

the “Swifter, Higher, Stronger” has gradually become the development target of our sports career, and “Much Higher, more precise and more sharp” is the trend of future development. However, in the traditional training, only with continuous exploring and summarizing experiences between theories and practices can physical educators form up dynamic adjustment and development and optimize the training effect. The whole training process is inefficient and hard to promote in a wide scale. Hence, to turn our country from a big sports country to a strong sports country, scientific methods and means should be applied in modern physical training. Scientific training can improve athletes' ability in a short time, make the training more scientific and systematic, improve training efficiency, save training cost and shorten the training period. So it becomes an essential research subject of how to use scientific method to improve the efficiency and effect of physical training (O'Donnell, C., & Sejnowski, T. J., 2016).

The development of VR technology can be divided into three phases: 1950s to 1970s is the preparation phase of VR technology; early 1980s to middle 1980s is the systematic phase of VR technology, when the technology started to walk out from labs to practices; late 1980s to early 1990s is the rapid development phase of VR technology. The first phase from 1950s to 1970s is the exploring period of VR (Meilinger, T., Schulte-Pelkum, J., Frankenstein, J., Hardiess, G., Laharnar, N., Mallot, H. A., & Bühlhoff, H. H., 2016; Alyahya, D., Johnson, E. G., Daher, N. S., Gaikwad, S. B., Deshpande, S., Cordett, T. K., & Zidek, L., 2016). In 1965, Morton Heileg from the USA developed a motorcycle simulator called Sensorama, which not only had the 3-D video and stereo effect but also can produce blowing feel and street smell. In 1968, the US computer scientist Ivan Sutherland organized and developed the first HMD (Helmet Mounted Display) and head position tracking system driven by computer graphics, which became an important milestone and laid the foundation for the development of VR technology (Pot-Kolder, R., Veling, W., Geraets, C., & van der Gaag, M., 2016). In the second phase from early 1980s to middle 1980s, the basic concept of VR technology has gradually formed, and the technology started to walk out from the lab to the practice. In 1985, Michael McGreevy accomplished the VIEW VR system with his team. They equipped the system with data gloves and head tracker, provided interactive means of gesture and language, which made VIEW a real VR system and become the VR system structure of future development. This event is also an important sign of this phase. Besides, VPL company also developed the RB2 software to generate virtual reality and DataGlove data gloves to provide developing tools for VR (Pavone, E. F., Tieri, G., Rizza, G., Tidoni, E., Grisoni, L., & Aglioti, S. M., 2016). The third phase from late 1980s to early 1990s is the overall development phase of VR. VR technology has been switched from trial period in lab to the practical period in market. The research of VR technology also turned from researches on basic theories and system construction to discussion of specific problems encountered in the application of VR. In VR system, except for various interactive devices, basic software supporting environment is also required for users to construct virtual environment and conduct advanced interaction with the virtual environment. To promote the wide application of V technology, it is necessary to analyze the software supporting environment structure of VR system. For example, Dialogue system put forward a mid-drive UMIS (User Management Interface System) based on event drive. The software system structure can conduct multi-process communications, which solved the dynamic flexibility of VR and promoted the development of software supporting environment (Killane, I., Fearon, C., Newman, L., McDonnell, C., Waechter, S. M., Sons,

K., ... & Reilly, R. B., 2015). In order to satisfy the almost infinite requirements of VR on the complexity of computation, the VR system should provide strong flexibility and expandability. To realize this, both of the aspects of the software and hardware can be considered. In the hardware system structure, DIVISON company proposed a basic parallel model in SuperVision system and developed related parallel processor parts and DVS operating system, which promoted the overall development of VR.

The application of VR technology in sports project can greatly increase the interactivity of the system. Usually VR systems are equipped with external interactive hardware, such as data gloves and 3-D display helmets. Based on these interactive devices, users can feel the real-time simulation and interaction through vision, hearing, touching, smelling and taste, etc. High degree of immersion is also one of the targets and evaluation standards of VR system (Becker, A. L., & Mailhot, E. K., 2015).

Users can feel the real-time simulation and interaction through vision, hearing, touching, smelling and taste, etc., and many physical training tasks also require the athletes to participate the training with multiple senses so that to achieve a better training effect (Martins, J., Gonçalves, R., Santos, V., Cota, M. P., Oliveira, T., & Branco, F., 2015).

2. Feature Analysis of VR Technology

The core of VR system mainly consists of hardware as computer, location tracking device, image capturing device, display equipment and other interactive devices and related software including the function units as the vision system with HMD as its core, auditory system with voice recognition, voice synthesis and positioning as its core, gesture tracking device with direction tracker, data gloves and data coating as its core, as well as the feedback system of taste, smell, touch and force sensing (Murphy, D. L., 2015).

2.1. Features of VR Technology

Among all the features of VR technology, the most basic and evident features include multi-sensory, immersion, interactivity and imagination. These unique features of VR are applied widely by users. The relationship between them is shown as Fig. 1.

Multi-Sensory: Except for the visual sensory feature that common computer technology also owns, VR technology also possesses the unique features of movement sensory, audio sensory, touch sensory and force sensory or even smell sensory and taste sensory features. Although computer virtual technology has a strong function, current VR technology only contains audio, force, visual, touch and movement sensory functions due to the restriction of some related conditions especially the restriction of the electronic sensing technology (Deal, E., 2016).

Immersion: Immersion can be also known as the on-site feeling, which means the attender can feel his/her role existed in the virtual world of the computer. This feature makes them feel the real attendance and hard to distribute whether it is a virtual world. With the visual, hearing, touch or even smelling exactly the same as the real world, they can get them completely involved in the 3D virtual world created by the computer.

Interactivity: The interactivity of VR technology changed the previous mode that users can only passively accept the information sent by the computer. Users can communicate

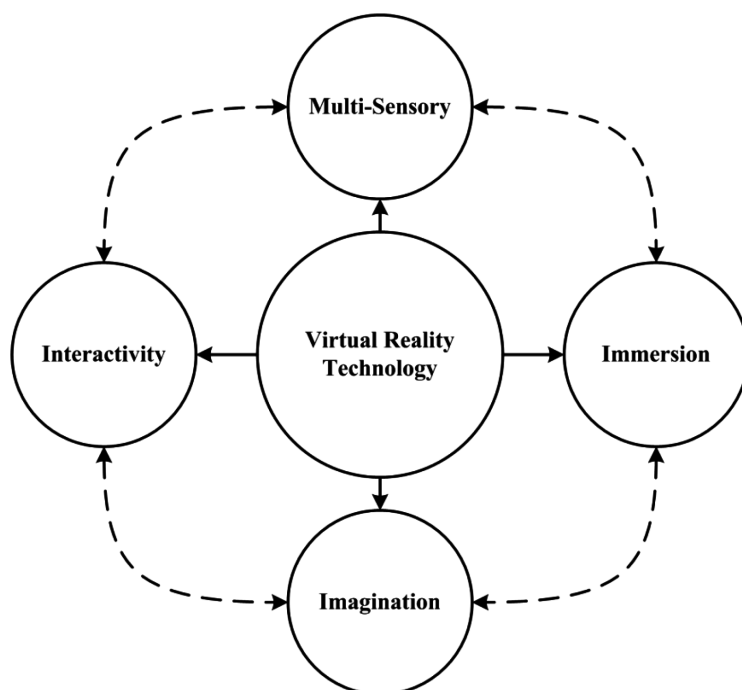


Figure 1 – The Basic Features of Virtual Reality Technology

and contact freely with various objects in the virtual environment through professional technical devices according to their own demands, or even can change the things in the environment, which can increase the natural feeling and sense of reality.

Imagination: Based on the strong developing function of VR technology, the imagination of VR technology can infinitely open human's imagination and change human's cognitive scope. Anything in the real life or imagined things that are impossible to happy can be realized through the imagination of VR. This feature can inspire people's imagination to a large extent.

2.2. Functions of VR Technology

The 3D information of human motion is the basis and key to scientifically analyze and study 3D motion of human body, which includes the information as different angle attitude and related 3D coordinates presented by all the bones and joints of human body during the process of body movement. The obtaining of human movement 3D information should first capture the dynamic technical movements of the athletes, then conduct force analysis and technical management (Backonja, U., Kneale, L., Demiris, G., & Thompson, H. J., 2016).

At present, although the acquisition method of 3D sports information has been developed from mechanical to electromagnetic type, "Active tracking method" is still the main method of 3D sports information acquisition (Dee, M., 2016). The method attaches special identification signs on each key moving part of the acquisition object. However,

as this method is not allowed in the rules of many sport games and due to the features of hi-tech and accuracy of modern sports development, attachment of identification signs on athletes in fierce competition will greatly impact the state as well the achievements of the athletes. Hence, how to obtain the real sports information of the athletes scientifically and reasonably is still a hard technical problem for sports scientists.

Proposed by Wang Zhaoqi, researcher of the Institute, Computing Technology of Chinese Academy of Sciences, the non-contact body movement tracking method based on video completely solved the technical problems and disadvantages of attaching special identification signs. This method arranges a certain number of video capturing devices at the sports training or competition site. First, it captures the whole process of the athletes' movements from multiple angles and directions (Zajkowski, A., & Stańczak, J., 2015). Then, the captured movement video is technically processed as sorting, editing and silencing with professional software. The method can prepare the important parameter data that each part needed for future 3D simulation of human movement.

3. Framework Design of VR Technology

The virtual training system function has the realistic virtual training ground. In 3ds MAX, models of virtual training ground and training devices can be created to generate vivid virtual training scene. Acquisition of physical data of athletes. Athletes' physical and psychological health data provide important references for the evaluation of the training effects of the athletes. The physical data of the athletes are obtained mainly by heart rate, electrocardiogram and blood pressure. Replay and presentation of movements. Virtual system can record and replay the technical movements of the user (athlete or coach), clearly state the defects between the two movements, which is useful for correcting wrong movements and presenting technical movements. Graphic training effect analysis. The presentation of the training effect and error analysis results in the form of graphic can directly reflect the training effect and standardized movements of the athletes, and help in the physical education and training.

3.1. Scene Rendering Based on Graphic Engine

OSG (Open Scene Graph) is a high-level, high-performance and high-expression 3D graphic rendering engine, which is freely published on the basis of revised LPGL protocol (OLPGL). OSG has been widely used in the developments of scientific visualization simulation, virtual reality, YiBiXing simulator and games, etc. Encapsulated and developed based on penGL, OSG is featured with object-oriented software structure.

As shown in Fig. 2, OSG can be divided into three parts according to the functions:

(1) OSG core library

The core library provided the basic graphic rendering function of 3D graphic engine, including the basic functions as the I/O operations of 3D model files and graphic files, real-time drawing of graphics, construction and operation of scene graphics, etc. OSG core library mainly includes OSG Library, OSG Util, OSG DB Library and OSG Viewer Library.

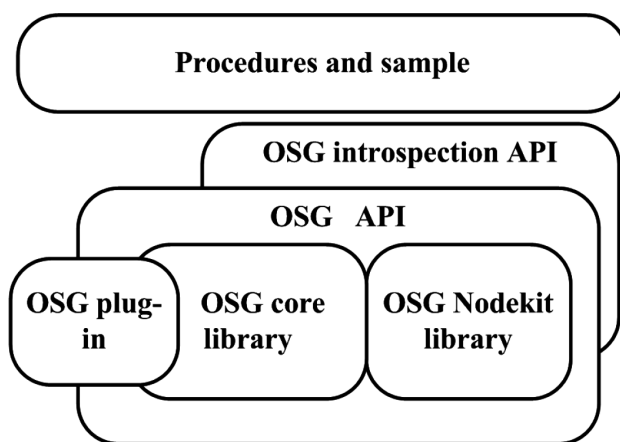


Figure 2 – OSG Frame

(2) OSG Nodekit library

Based on OSG core library, Nodekit provides more functions and effects for the rendering. The combination of Nodekit and OSG core library forms the API of OSG.

(3) OSG plug-in library

Plug-in provides more abundant and stronger functions, which further facilitated the development. For example, the plug-in with model file format can provide the read and write interface for various 3D model files, which makes the I/O operations of the files easier. The plug-in mechanism makes it easier for OSG to extend third party applications with more functions.

3.2. Object Design of VR System

The fundamental objective of VR system is to assure the attenders could naturally interact with the virtual environment and achieve the real experience. Based on different interaction and immersion degree, VR system can be divided into desktop VR system, immersive VR system, reinforcing VR system, and distributed VR system. Immersive VR system can make the users completely immersed in the environment created by computer with immersive effect. However, due to its high requirement of hardware and high cost, it is not appropriate for commercial development and application. Desktop VR system takes the computer screen or projection screen as the observation window of virtual environment. Users need to use handheld input device or position tracker to control the objects in the virtual environment. For example, the “Body feeling game” is very popular for its low cost and simple control.

3.3. Interactive Function Design of VR System

The structure of VR system is shown as Fig.3. VR system takes the real world as its noumenon, makes a 3D model and changes it to the virtual world. Then the virtual world combines the inner system and constructs a closed feedback control loop through the

screen and sensor, etc. With users' control and operation, it realized the interaction between the virtual environment and the real world.

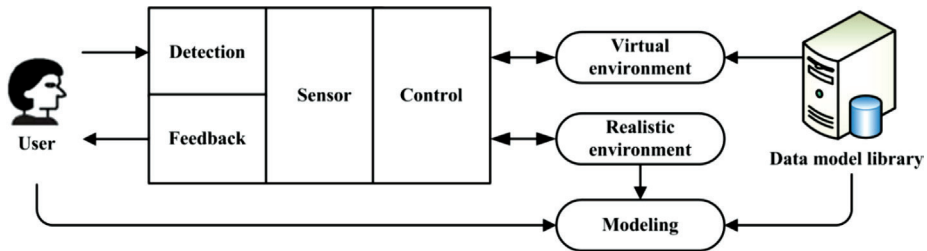


Figure 3 – Virtual Reality System Frame

The principle of the desktop virtual physical training system is shown as Fig. 4. To create virtual environment, the first step is to obtain the 3D data of the real world, then establish 3D modeling and integrate all the single 3D models to create the same virtual environment as the real world. Computer obtains users' sports information through hardware as data gloves, data clothes or position trackers, input the obtained information into the virtual environment in the computer through 3D sensor. When the users' sports information acts on the virtual information, the computer will convert the data information into 3D image and present to users via image display, and realize the natural interaction between users and the virtual environment. Meanwhile, auxiliary tools as mouse and keyboard can help users switch and control the display and interactive functions.

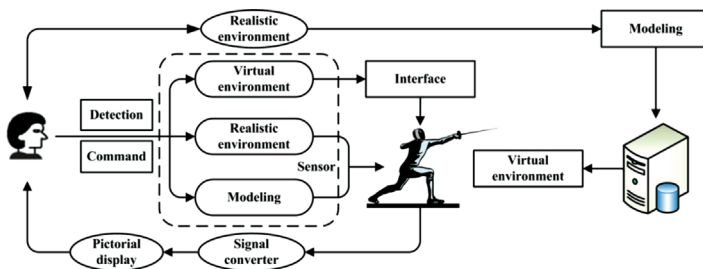


Figure 4 – Desktop Virtual Training System Schematic Diagram

The structural design of virtual physical training system is shown as Fig. 5. The interface design is the first page of the system when users open the system. As the core design of the system, the design of 3D scene and virtual role is also the most complicated technology, including scene modeling technology, virtual human modeling technology and collision detection technology, etc. The virtual environment is controlled by users. The sensor device obtains the movement and gesture data through data clothes, data gloves and position trackers so that to control the virtual environment.

As shown in Fig. 6, physical training system also has certain interactive functions during its application. The combination of physical theories with technical and strategic education with animation showing of virtual human not only can facilitate the education, but also can help the athletes master the sports technique and improve their sports level.

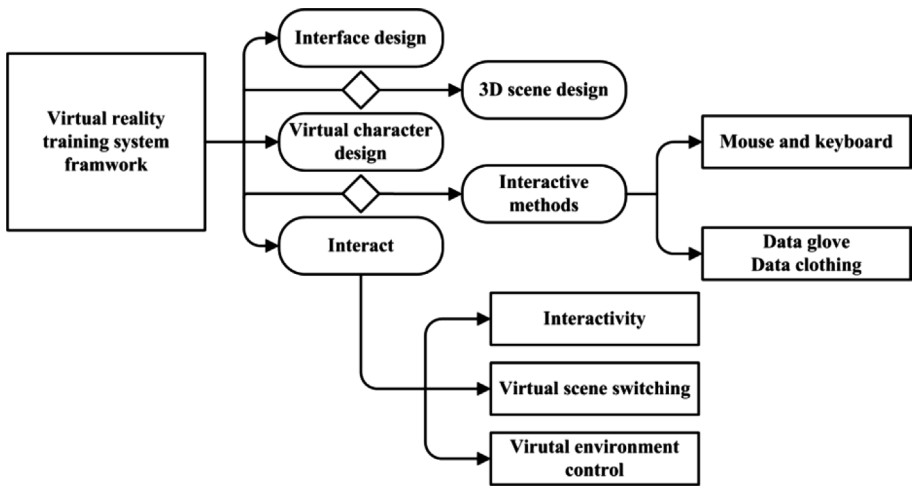


Figure 5 – A Virtual Training System Structure Diagram

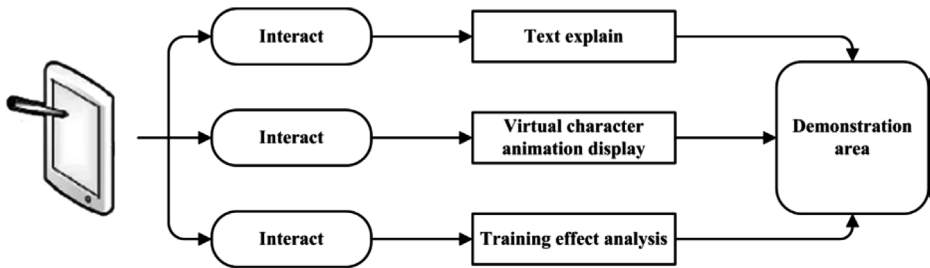


Figure 6 – The System has the Function of Interaction Frame

4. Applications of VR Technology in Physical Training

4.1. Application of VR Technology in Diving

Technical motion innovation is the lifeline of difficulty-oriented group competition. However, in the technical innovation, there may be huge injury risk if the experiment directly takes human as its objects. Hence, it has special practical significance to conduct the VR study on this subject. The basic idea of the study includes three steps: First, accomplish the simulative computation of 3D human motion on the basis of Lagrange’s Dynamical Equation. The virtual athlete would attempt to accomplish the new action that the simulative technical coach taught. So that the probability of athlete’s accidental injury during the innovative training will be reduced to the maximum; Secondly, smoothing computation will be conducted through the relearning function of neural network and the arrangement and selection of computer auxiliary motions will be accomplished from the programmatic and theoretic perspective; at last, extract the real technical parts from the training and competition video of the athlete. Then compare the simulation movements and actual movements of the athlete on a same screen with

different displays through video-editing software. This method can help the coach and athletes discover the slight differences in the technical movements.

The coach divided the diving athletes into Group A and Group B to proceed a new action diving training, with 5 athletes in each group. Group A is trained with the supporting of VR technology. Group B is trained with traditional teaching method. Each group dived 10 times, totally 50 times. After 50 times diving training, a test will be carried out on the two groups. The comparison of error rate, injury rate and action accomplishment rate (10-point system) during the test is shown as Table 1.

Table 1 – Virtual Reality Technology Diving Comparative Analysis

Group	Number	Success rate	Injury rate	Action completion	batting average	The average rate of injury	The average action completion
A	A1	85%	10%	9.3	81%	13%	8.38
	A2	75%	15%	7.5			
	A3	70%	20%	7.6			
	A4	85%	10%	8.5			
	A5	90%	10%	9.0			
B	B1	70%	35%	7.1	63%	48%	6.24
	B2	50%	60%	5.0			
	B3	65%	50%	6.5			
	B4	70%	45%	6.6			
	B5	60%	50%	6.0			

According to the comparative results of the diving tests with VR technology and traditional method: For the athletes in the Group A trained with VR technology, the average success rate reaches as high as 81%, the injury rate is as low as 13%, and the average grade of the new diving action accomplishment is 8.38; for the athletes in the Group B trained with traditional method, the average success rate is only 63%, the injury rate is as high as 48%, and the average grade of the new diving action accomplishment is only 6.24. According to the quantitative analysis of Group A and Group B, VR technology has a remarkable effect on diving sport as well as the diving athletes. It can also help coach to adjust the status of the diving athletes and teach the points of each action.

4.2.Application of VR Technology in Trampoline

In order to accurately obtain the movement data of the trampoline players and optimally arrange the technical movements, a technical data library of trampoline should be established first. Then a standard technical movement library is established to precisely capture and analyze the collected human body movements and data, as shown in Fig. 7. Technical staff installed 6 dedicated cameras at different positions in the training center. The traditional active tracking data acquisition method is adopted. More than

20 reflective marks were installed at specified positions on the trampoline player. When the player is accomplishing the trampoline movements, the cameras will record the movement parameters as positions and speed at each position and store in the computer. So that a huge trampoline movement technical data library will be established. Then the coach and researchers can summarize the rules of trampoline by sorting, classifying and comparing the related information in the data library. Meanwhile, the data library obtained by the test can be also edited, revised and perfected by the coach according to the trampoline standard of “Steady, accurate, high, difficult and beautiful” and the specific scoring standard of the judge.

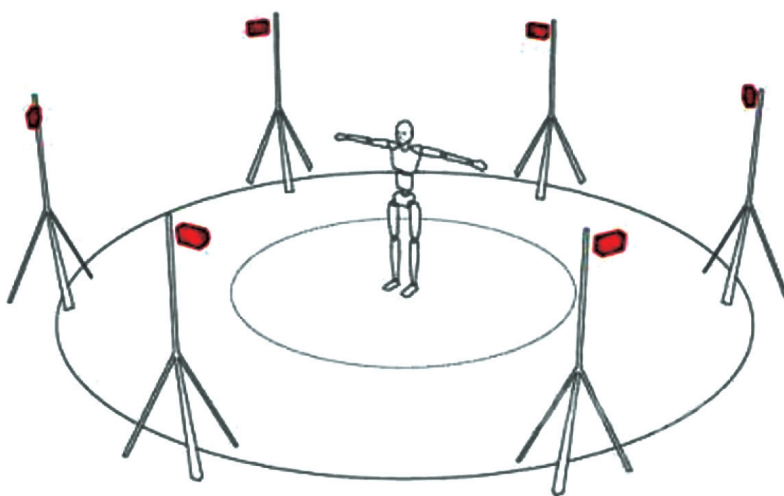


Figure 7 – Virtual Reality Technology Applied in Trampoline

With this data library, the coach can set “ideal” new actions and eventually forms a series of actions. With the simulation and emulation and auxiliary training through computer technology, the system can change the situation from that athletes accept abstract oral training of coach to that they receive graphic technical actions and visual practice guidance as well as the quantitative classification of related actions. In this way, the athletes can easily master the points of the technical actions in a shorter period. During the training, the system can synchronously compare the whole set of training actions of the athletes with the standard simulative actions designed from coach’s idea on the computer screen. It can directly present the action differences and help athletes find out technical shortcomings and make improvement plans to greatly enhance the overall sports level of the athletes. In addition, based on the characteristics and sports ability of each athlete, the system can simulate the optimal action standard under the optimal physical condition of each athlete to direct their daily training and achieve the goal of optimal auxiliary training effect.

5. Conclusion

Based on quantitative analysis of technical actions and graphic display of the analysis results as speed and force, VR technology conducted a deeper analysis on the “ideal” action

and athlete's technical action and created a virtual training and competition environment for the athlete, which can make up the negative impact brought by cancelation of training due to factors of weather or ground or device costs, or injury of the athlete, etc.; through the comparison of simulation result and athlete's actual training videos by displaying the athlete's training action and the standard simulation action on a same screen and comparing synchronously in the same perspective, the coach and athlete can analyze the action difference, find out technical shortcomings and enhance them to improve their training results; it can also enable a virtual athlete to attempt the new action so that to avoid the sport injury caused by the difficult and complicated technical action, and to reduce the risk of sport training. VR technology has a huge effect on modern competitive sport technology.

Acknowledgment

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Realization of Automobile Marketing Management System Based on .NET Structure

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Abstract: With the development of our automobile industry and increasing demand of automobiles, automobile marketing management became an indispensable tool for automobile marketing industry, and the automobile marketing management system based on .NET structure is more convenient for all the processes of automobile marketing. This system is designed according to the characteristics of modern automobile marketing industry and the working habits of marketing personnel. The system is based on Microsoft's .NET structure with ASP.NET as the Web program framework and SQL SERVER as the data base. It is a B/S structured automobile marketing management system programmed by C# language. The system mainly contains five modules including automobile information management, sales information management, customer relationship management, stock information management and financial information management. The automobile marketing management system based on .NET structure changed the mess of data information of traditional mode, which makes the process of automobile marketing more systematic. Experiment shows that the system can preferably satisfy the demands of automobile marketing in the aspects of stability, interface display, adding or deleting of data.

Keywords: Automobile marketing; .NET structure; B/S structure; C# language.

1. Introduction

With the rapid development of modern information technology and E-commerce, more and more enterprises started to use computer and network resources to improve their competitiveness. Information system can help the enterprises take the leading positions in the aspects of production efficiency, delivery time as well as their service level. Supported by information system, enterprises not only can treat daily affairs effectively, optimize business procedures, bring down production cost, but also can use them to analyze the consumption trend of customers and improve their service level for customers. Hence, the adoption of information system is a basic requirement of modernized management of enterprises as well as the essential condition of normalized and socialized management of enterprises. In recent years, automobile industry developed very fast, and China has become the largest automobile market in the world. There are a certain disadvantages of traditional marketing modes as automobile shops, multi-brand shops, automobile transaction market and automobile industrial part, etc. So it became a basic necessity

to adopt a practical software to solve a series of problems as sales management, stock management and customer relationship management, etc. The automobile marketing management system developed based on ASP.NET technology has the advantages of low development cost, low implementation costs and simple maintenance, which can realize most of the functions of traditional marketing management software. In 1985, Berkovec J specifically stated the new mode of automobile marketing (Talbot, C. C., 2015). In 2001, Agrawal S specifically introduced the practical use of SQL SERVER 2000 (Batra, P., 2015). In 2002, Rongge M D L introduced the Web programming of ASP.NET platform (Singh, A., Rana, A., & Ranjan, J., 2015). In 2004, Benton N clearly explained the programming mode of C# language. In 2008, Kaplan R S conducted an innovative design on the mode of modern information management system (Dasgupta, P. S., & Maskin, E. S., 2015). Adopted with Microsoft's .NET structure, this paper designed the automobile marketing management system based on ASP.NET platform. With C# program and taking SQL SERVER 2000 as the data base, this system makes the automobile information management, sales information management, customer relationship management, stock information management and financial information management more convenient and systematic (Martins, J., Gonçalves, R., Santos, V., Cota, M. P., Oliveira, T., & Branco, F., 2015).

2. Develop Environment and Technology of Automobile Marketing Management System Based on .NET Structure

2.1. Development Framework of the System

1. Brief introduction of .NET

In June 2006, Microsoft company publicized Microsoft. NET. Few years later, Mircorsoft.NET technology and related products were widely used (Quirós, T. P., & Mehndiratta, S. R., 2015). .NET is a group of software components used to establish Web server applications and Windows desktop applications. It is a software development platform dedicated to agile software development, rapid application development, platform independence and network transparency. The .NET framework diagram is shown as Fig. 1 (Martins, J., Gonçalves, R., Santos, V., Cota, M. P., Oliveira, T., & Branco, F., 2015).

As shown in the diagram, CLR (Common Language Runtime) and .NET Framework class library are two essential core modules to develop applications on .NET platform. As a software engine, the core functions of CLR include exception handling, thread synchronization and memory management etc. The objective of CLR is to improve the safety and stability of applications and reduce the volume of the system bottom codes compiled by the developer. .NET Framework class library is the basis of .NET applications, controls and components. It is an integrated and object-oriented reusable type set. Microsoft's .NET Framework class library provides the necessary public codes for program development and allows users to use the class of the extension class library define their own classes. With their own advantages, CLR and class library consisted Microsoft's powerful .NET platform, which contains abundant development tools and also supports normal programing languages.

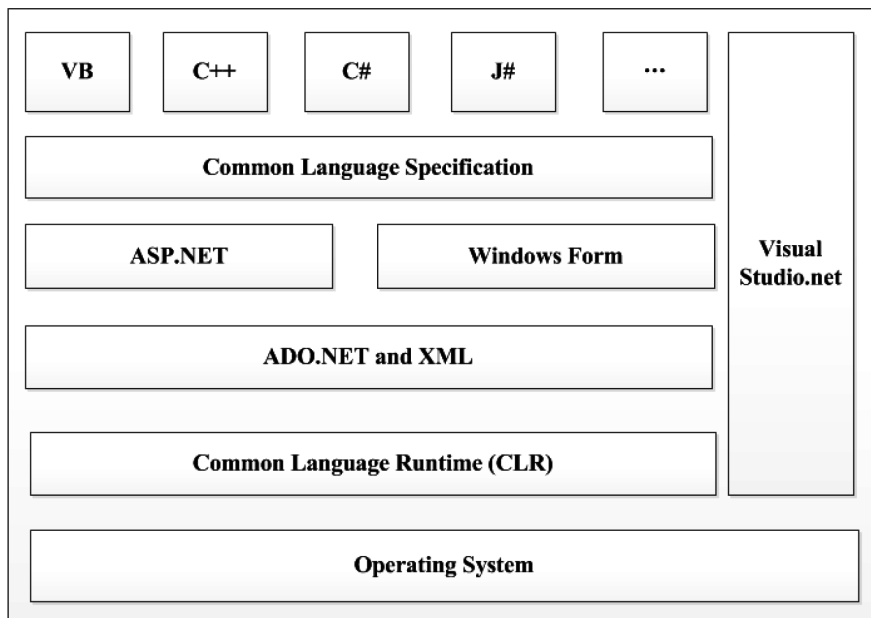


Figure 1 – NET Framework Diagram

2. Brief Introduction of ASP.NET

Established on .NET platform structure and previously known as ASP (Active Server Pages) technology, ASP.NET is a programming framework that provides users with strong enterprise-level Web application services at the server backend. ASP.NET applications can take advantage of .NET platform and the advantages of CLR and .NET Framework, use strong development tool of .NET, create dynamic or complicated Web applications and reduce the threshold of Web application development (Han, S., Seo, S., & Choi, H. J., 2015).

ASP.NET technology mainly has following features: (1) High-efficient running performance. As a compiled public language runtime library code, ASP.NET stores code page and preface page separately, which makes ASP.NET applications like Windows applications, the code pages can be compiled to generate DLL files. Besides, ASP.NET adopts buffering mechanism, which improved the running performance of the pages. (2) Flexibility. ASP.NET has no direct relationship with any language, neither it depends on any Web browser. Developers can select their favorite languages to create numerous Web applications or conduct their developments, which represented the flexibility of ASP.NET. (3) Simplicity. Based on object-oriented development technology, ASP.NET makes it simple to execute daily tasks. For example, ASP.NET allow users to divide their own interfaces. It is also simple to submit forms and conduct identification. (4) Strong development tool support. ASP.NET and Visual Studio.NET use strong development tool of .NET, such as a series of servers controls, etc. (5) User-defined and extensible. ASP.NET allows developers to add any of their own defined components to replace any sub-components in the ASP.NET runtime library.

It also allows users to “insert” code at appropriate level, or define “plug-in” module in their own code, which can improve the reuse of the code. (6) Safety. ASP. NET allows to allocate each application and add any identification on the application, which improved the safety of the program.

3. Brief introduction of ADO.NET

Developed from ADO (Active X Data Objects), ADO.NET technology is the data access interface preferentially used in the .NET programming environment. ADO. NET is an important technology that exceeded ADO. It provides new generation of data access service, through which data sharing user can search, operate and update the data. With advantages of interoperability, easy maintainability, programmability and high performance, ADO.NET technology is consisted of a series of related libraries and interfaces of data base with XML technology as the basis. So by applying ADO.NET technology, applications can not only visit the data in the relational data base but also can visit the hierarchical XML data (Parva, M., Dola, K., & Pour Rahimian, F., 2015).

4. Brief introduction of C#

Born with .NET, C# programming language is new programming language developed with Microsoft. Derived from C and C++, C# programming language has powerful functions, including flexible syntax, preferable support on dynamic Web page, efficient data access, and ability of solving code sharing problems, etc. Meanwhile, C# is also an object-oriented program development language with common advantages of program design languages, such as inheritance, encapsulation and polymorphism, etc. Considering the advantages of C# programming language, all the programming languages in this automobile marketing management system adopted C# programming language (Jadhav, S., & Sawant, N., 2016).

2.2. Introduction of B/S Working Mode of the System

B/S (Browser/Server) working mode appeared with the wide application of Internet. Developed with the basis of traditional two-layer C/S mode, B/S mode applies to the three-layer C/S structure modes of the distributed environment, including the presentation layer, function layer and data layer; the presentation layer mainly accomplishes user interface function, inspecting user input data and displaying output results of user applications; the function layer integrates the traditional applications at the customer terminal and server terminal and consists the application server; the data layer mainly takes charge of the visit, management and maintenance of the data base (Sucheran, R. E. S. H. M. A., 2015). The three-layer structure model of B/S is shown as Fig. 2.

Designed with three-layer structure, B/S has advantages as good expansibility, simple to maintain and upgrade. When there is any change of processing, only the business component module on the application server rather than the whole system needs to be updated, and the change of user terminal will not influence the business logic layer and server layer. Besides, the B/S structure system has high running reliability. All the business data are processed at the server terminal, which is easy to control; in addition, B/S mode also provided more space options for users. Microsoft's browser at the customer terminal is very important. However, there are a certain number of operating systems at the server terminal. Users can make their choices according to their own demands (Powers, C. N., 2016).

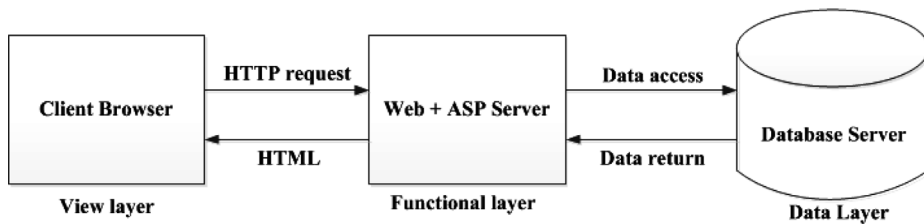


Figure 2 – B/S Three-Layer Structure Model

2.3. SQL Server Data Base

SQL Server is a relational data base management system initially developed by Microsoft, Ashton-Tate and Sybase. Then the three companies developed corresponding versions according to different operational systems. Microsoft transplanted SQL Server to the Windows NT system. SQL Server provided convenient platforms for current data management of enterprises. Its safety and reliability are approved by the users, and its versions are also updated for many times.

The system data base technology designed in this paper adopted SQL Server 2000, which is a large relational data base management system by Microsoft. SQL Server 2000 can better support B/S structure mode and truly realized the integration of data on the server terminal; besides, it has a friendly user interface with graphical operation. Users can operate without the need of remembering complicated SQL sentences, which reduced the difficulty of operation. Another advantage of SQL Server 2000 is that it allows to use user-defined function, which can reduce the redundancy level and error rate of the program, and facilitate future maintenance.

3. System Analysis

3.1. Analysis of System Demands

The users of the system stated in this paper include the salesman and administrators of each department of the automobile company. The system is designed according to the business procedures of the company. Its goal is to realize the informatization of automobile marketing management and promote the unification and coordination of the logistics, information flow and capital flow of the company (Achim, M., 2016). Based on previous investigation and analysis, this paper summarized the functional demands of the system as follows:

1. Automobile information management. This module is designed for the activities as purchasing, storing and marketing of automobiles of the distributors. The important information of the automobile includes the brand, series, grades and names, etc. The unified management of the information can facilitate the business procedures of the distributors.
2. Stock information management. The main function of stock management is to record detailed inbound, outbound and inventory information. Different from manufacturers, automobile distributors usually own few stock for sales and shows only.

3. Sales information management. Automobile distributors hope to manage the sales contracts through the system. By querying and summarizing the sales orders, they can analyze and summarize the sales status and make reasonable sales prices and purchasing plans.
4. Financial information management. With the sales and purchasing, related accounts receivable and accounts payable will be produced. Automobile distributors hope the system can have the functions of querying the accounts receivable and accounts payable in time. Accurate financial information can help the company improve the recovery rate automobile payment, accelerate the capital flow and provide financial support for all the business of the company.
5. Customer relationship management. Originated from marketing theory, customer relationship management is mainly used to maintain customer relationship, accumulate customers, improve after-sales service level and customer satisfaction. In the automobile industry, distributors pay much attention to customer relationship management, take customer information as an important strategic resources, and establish the customer-oriented management concept. As automobile distributors not only distribute automobiles, but are also responsible for the after-sales service of the brand, so they hope the system can represent and add certain importance to the customer relationship management.

The overall functional demands of the system are shown as Fig. 3:

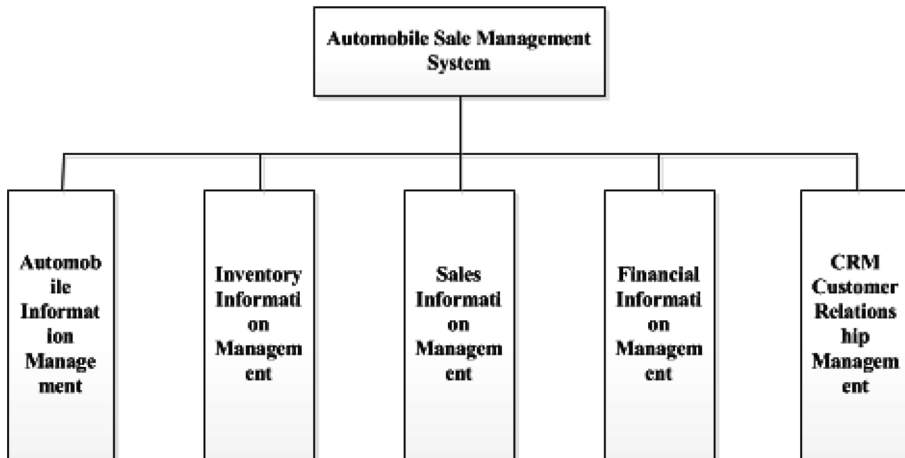


Figure 3 – System Overall Functional Demand Diagram

3.2. Analysis of Transaction Procedure

The most commonly used analytic tool of business procedure is TFD (Transaction Flow Diagram). TFD uses concise symbols to describe business procedures. It can describe the information resources, information flow and processing method of each business procedure, which facilitates the analysis and treatment of the developers.

Taking the sales business of automobile distributors, the TDF is shown as Fig. 4.

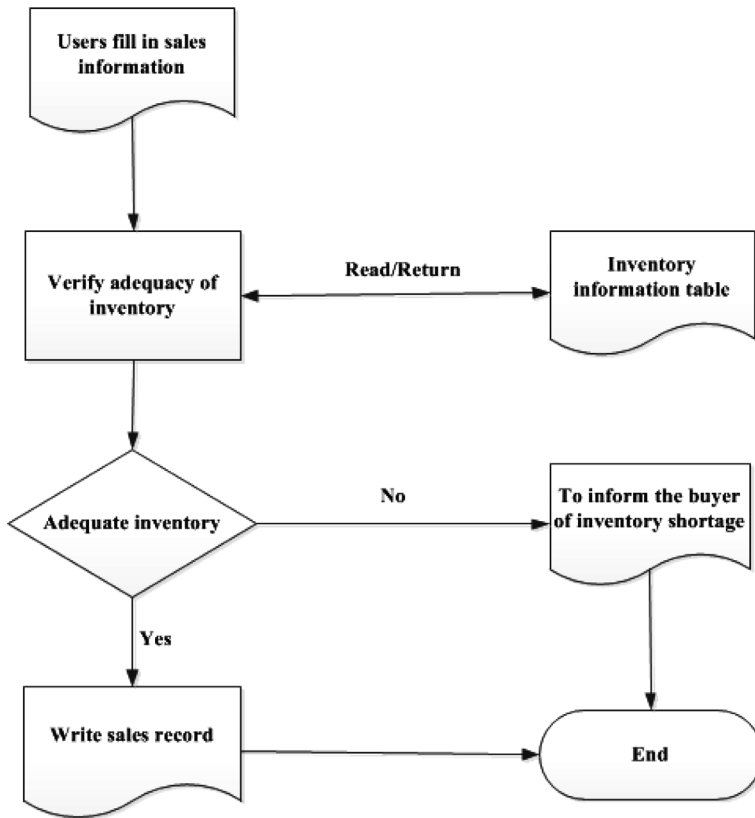


Figure 4 – Sales Business Flow Diagram

3.3. Feasibility Analysis of the System

The feasibility analysis of the system is to confirm whether the development of the system has required conditions in multiple aspects based on previous investigations. The feasibility analysis of this system mainly contains following aspects.

1. Economic feasibility

Economic feasibility can be divided into cost analysis and efficiency analysis. By comparing the two aspects, the development of the system will be demonstrated to be economic or not. System development cost includes equipment cost, development cost, operation and maintenance cost. The required equipment of the system includes the host, server and networking devices. The equipment cost will be greatly reduced if virtual host is adopted; the development and maintenance costs will be also low when using browser as the system customer terminal with B/S working mode (Marinelli, E., Vergallo, G. M., Busardò, F. P., & Zaami, S., 2016). The estimation of the system efficiency is relatively difficult. Because some of the benefits cannot be measured directly by money. However, it can be also represented from the aspects of the improvement of information resource utilization rate, decrease of stock and speed of capital flow, etc. With the functions in these aspects, the system can provide an overall information

platform for automobile marketing and remarkably improve the economic efficiency of the automobile distributors.

2. Technical feasibility

Technical feasibility refers to the feasibility of realize the system development according to current technical conditions. In software, the system uses the popular B/S three-layer structure model and closely combines Internet/Intranet technology, which is the trend of the technical development; the data base adopts the SQL Server 2000 technology to process abundant data. The flexibility and safety also provided preferable basis for the system development; developed on the basis of ASP technology, ASP. NET not only has the advantages of ASP technology, but also can use .NET technical framework, which has abundant advantages with matured and advanced technology. In hardware, the memory and computing speed of computers keep on growing, the functions keep on perfecting and the capability and quality of networking and communication devices keep on strengthening. Current software and hardware technologies can satisfy the requirements of system development completely.

3. Management feasibility

Management feasibility refers to whether the administrators' attitudes on the system development and the management conditions allow the development of the system. For example, the cognition, desire and eager of business administrators, attitudes and views on the system development of the company leaders all influence the management feasibility of the system development. The system designed in this paper can provide professional support for the related business of automobile marketing and promote the standardization and normalization of the business procedure of automobile marketing. The enterprise senior can realize the importance of the marketing system. So it has the management feasibility.

4. System Design

Based on the demands of the automobile distributors on the system functions and the structural design principle of the system, the automobile marketing management system can be divided into six modules: automobile information management, stock information management, marketing information management, financial information management, customer relationship management and system user management.

1. Design of system sub-module

Taking automobile information management sub-module as the example, the module includes automobile brand management, automobile series management and automobile detailed information list. Users can revise, add or delete the brand or series of the automobile, or edit or review the information of the selling automobiles. The management sub-module of automobile information is shown as Fig. 5.

2. Operation procedure of the system

When entering the system, user needs to input username and password, and then verify the identification. Only when the user is succeeded in the verification, he/she can use the system. The system function flow chart is shown as Fig. 5.

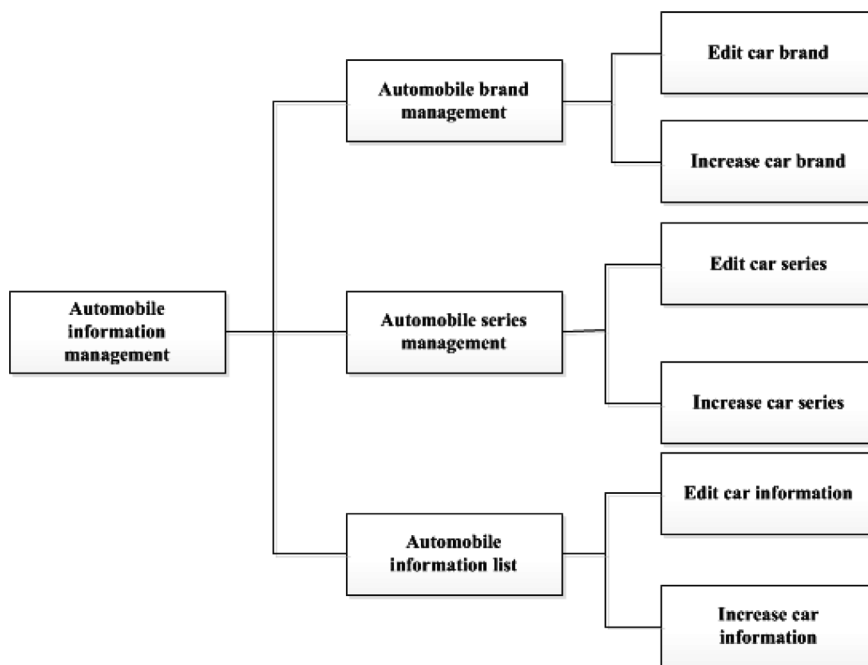


Figure 5 – Automobile Information Management Sub-Module

3. Design of system data base

Data base is the key and basis of information system design. Data base is established to organize, store and manage the data according to the data structure. It greatly facilitated the functions of storage, maintenance and searching of the data. There are a lot of types of data base. At present, relational data base is the most commonly used data base.

Taking the automobile information management module as the example, the data table and structure of the management sub-module of automobile information is shown as Table 1.

Field	Field meaning	Data type	Length	Whether to allow empty	Whether the primary key
<i>GoodsID</i>	Car ID	int	4	No	Yes
<i>TypeID</i>	Brand	int	4	Yes	No
<i>BorderID</i>	Car category	int	4	Yes	No
<i>GoodsLevel</i>	Car level	int	4	Yes	No
<i>GoodsCode</i>	Car code	nvarchar	10	No	No
<i>GoodsName</i>	Car name	nvarchar	50	Yes	No
<i>GoodsPic</i>	Car pic	nvarchar	50	Yes	No
<i>GoodsCheck</i>	Car check	nvarchar	50	Yes	No

Table 1 – Automobile Information Management Table

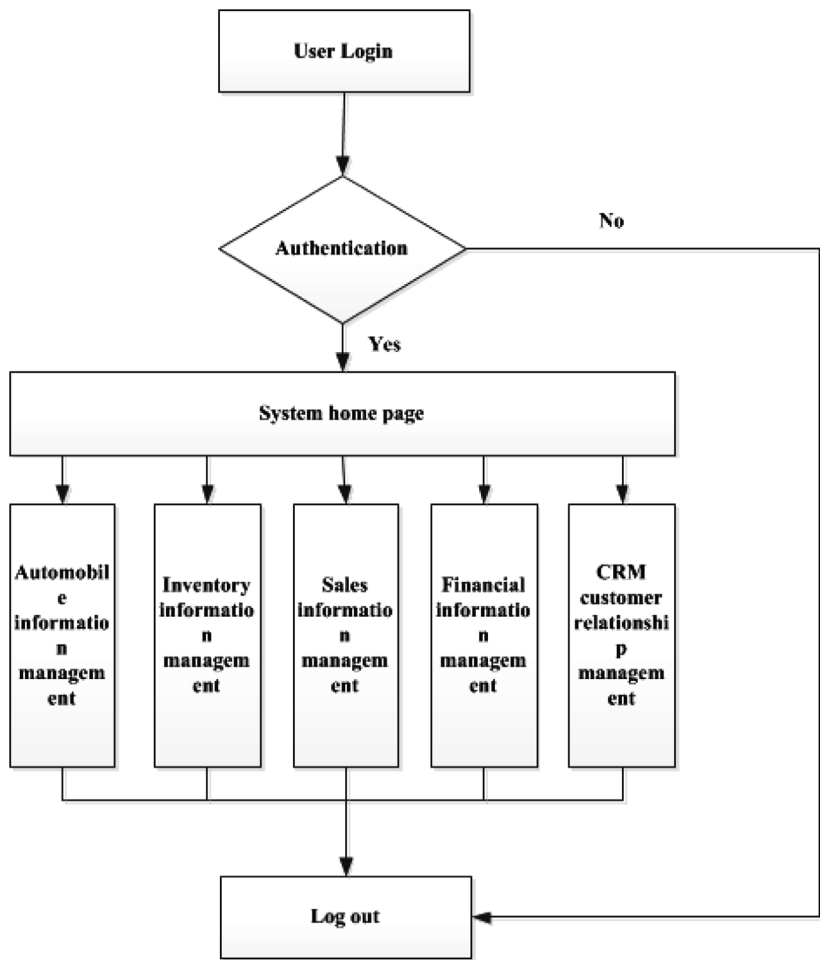


Figure 6 – System Function Flow Chart

5. Realization of the System

5.1. Connection of ADO.NET to Data Base

When ADO.NET is visiting the data base, the connection to the data base needs to be created first. The connection of ADO.NET to the data base is realized by the connection object (Bolan, M. M., 2016). The data base name of the system is Car Sales. The sales management and data base shares the same server. The system can be connected to the data base through “web.config” configuration file.

5.2. Design of System Login Module

The first page of the automobile marketing management system is the login age, which provides the entrance to the system for users. To avoid the login of unauthorized users,

users need to input correct username and password before entering the system. When no username or password are input, the system will pop up related information.

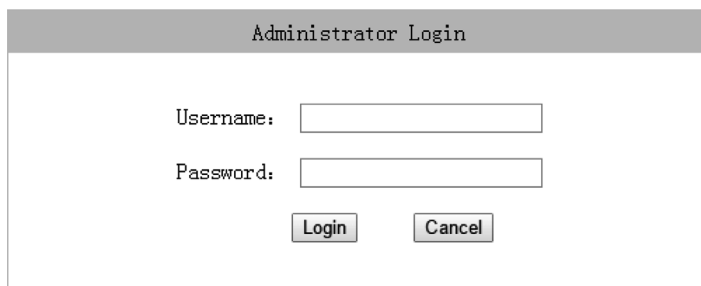
A screenshot of a web form titled "Administrator Login". The form has a light gray header bar with the title. Below the header, there are two input fields: "Username:" followed by a text box, and "Password:" followed by a text box. At the bottom of the form, there are two buttons: "Login" and "Cancel".

Figure 7 – System Login Page

5.3. Main Interface Design of the System

The home page of the system adopts the framework technology, including top operation area, left operation area and right operation area. The three pages of the system are Top.aspx, Left.aspx and Main.aspx. The top operation area mainly displays the system name; the left operation area displays the menu navigation of each function of the system; the right operation area mainly displays data. The home page design of the system is shown as Fig. 8.

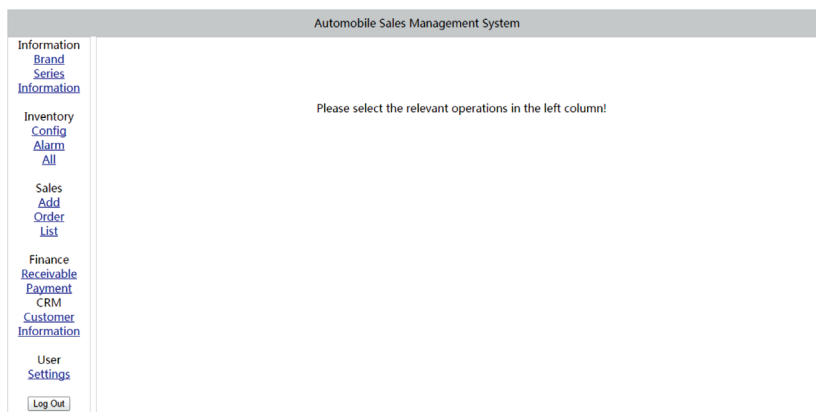
A screenshot of the "Automobile Sales Management System" home page. The page has a light gray header bar with the system name. On the left side, there is a vertical menu with several categories and sub-items: "Information" (with sub-items "Brand", "Series", "Information"), "Inventory" (with sub-items "Config", "Alarm", "All"), "Sales" (with sub-items "Add", "Order", "List"), "Finance" (with sub-items "Receivable", "Payment", "CRM", "Customer", "Information"), and "User" (with sub-item "Settings"). At the bottom of the menu is a "Log Out" button. The main content area on the right has a light gray background and contains the text "Please select the relevant operations in the left column!".

Figure 8 – System Home Page

5.4. Realization of the System Sub-Module

Taking automobile information management module as the example. The automobile information management includes three sub-options as automobile brand management, automobile series management and all automobile information lists. When clicking the menu link of the three sub-options at the left, the right page of the system will respectively display all the automobile brands, series and detailed information that input in the

current system. On account of the three types of automobile information management contents, the system provides the revise, delete and add functions. Taking the automobile information management for example, when clicking automobile information list, the system will list the simple information of all the automobiles of the distributor.

For each automobile information, click “EDIT”, the system will display the detailed information of the automobile; click “ADD”, the user can increase the information of the automobile. The adding page of automobile information is shown as Fig. 9.

Add Car Information

Brand:

Brand Select ▾

Series:

Series Select ▾

Level:

Level Select ▾

Number:

Name:

Engine:

Describe:

Picture:

Browse

Upload

Whether audit:

No ▾

Assessor:

Assessor01

Submit

Clear

Figure 9 – Add Automobile Information Page

6. System Test

System test is an important step of verifying whether the system can satisfy all the demands and assuring the proper functioning of the system. It is a comprehensive review of the whole designing procedure of the system. The goal of the system test is to conduct specific and strict software test to discover the errors and omissions during the analyzing, designing and realizing period of the system, correct them to perfect the system functions and satisfy the demands of users; besides, the test is carried out to verify the quality of the system, evaluate the risks in the system, send feedback information to developers and users and make sufficient preparations for the application of the sales management system.

6.1. Test Scheme of the System

Traditional system software test mainly includes program test, module test and system overall test. Program test refers to the test of single program, such as input program, query program, report program. In this test, programming personnel would conduct syntax checking and logic checking of the single program, mainly testing the logic correctness of the program. The module test is also known as unit test. The main purpose of module test is to assure the correctness of the internal control and data processing as well as the running efficiency of the module. It assures the normal operation of the module as a unit. The overall test of the system refers that after the tests of each module are accomplished, the main control program will be combined with each sub-system to conduct the overall test to verify whether the whole system can work as a whole.

1. Test environment

The system test environment designed in this paper mainly includes the user terminal and the server terminal. The specific requirements are shown as following:

Client terminal:

Internet Explorer

Windows XP/7

Microsoft office 2013

Server terminal:

Microsoft Windows Server 2003

Internet Information Server (IIS)

Visual Studio 2010

.NET Framework

Microsoft SQL Server 2000

2. Test content

The test content of the system mainly includes function test, performance test and usability test. The function test mainly focuses on whether each function page can correctly display the page information, including link test, programming language test, form test, data base test as adding, editing and deleting data, input and query test, and page overall display test, etc. The system performance test mainly checks whether the system can return the prompt of correctly handled, the abnormal handling can satisfy the expectation. Besides, it also tests whether the system structure can deal with large-load business, as well as the response ability and throughput rate of the system, etc. The main content of this test includes interface display, adding, deleting, revising and checking of the data base.

6.2. System Test Results

Based on the system test scheme, this part carried out a strict test on the system, and displayed the actual running effect of the system through the screenshots of some key pages.

The related operation test results of the data base are shown as Table 2.

Number	Test Case	Case description	Test Results
001	Add	Add sales order	Success
002	Delete	Delete system users Seller04	Success
003	Statistics	Number of customers by month	Success

Table 2 – Database Edit, Add, Query Test

Order Details [Back to previous](#)

Order sales information

Sales Order No.

Sales Time

Sales price

Seller

2015120201

20151202 14:01

13500

Seller03

Order Customer Information

Username:Wang Yi

Address:Tianfu Avenue No.126

Zip Code:610000

Tel:13567854567

E-mail:wangli@gmail.com

Orders Automotive Information

Name:Mazda3 Axela 1.5L Automatic comfort

Engine:1.5L 200hp L4

Transmission:5-speed automatic

Figure 10 – Order Add Test

The test results are shown as Fig. 10. The input information can be correctly saved in the data base and the system can correctly display the data. The whole test results are in accordance with the predicted results, which shows that the data base is correctly connected and the functions can satisfy the demands.

For the test of structure loading ability, response ability and throughput rate of the system in the local test phase, the response time at the customer terminal of the system is 1-2 seconds, which shows that the system has a rapid processing speed with preferable

influence performance; at the remote test phase, the response ability is related to user's hardware and network performance. This round of test is just a trial test in a small scale. Hence, the current loading test and pressure test cannot be implemented completely. It will be the important part of the next test.

7. Conclusion

With the development of automobile industry, an excellent automobile marketing management system is playing a more and more important role. This paper first introduced the development environment and key technologies of automobile marketing management system, then conducted specific systematic analysis and designed the automobile marketing management system based on the characteristics of modern automobile marketing industry and the working habits of the salesman. The system is based on Microsoft's .NET structure with ASP.NET as the Web program framework and SQL SERVER as the data base. It is a B/S structured automobile marketing management system programmed by C# language. The system mainly contains five modules including automobile information management, sales information management, customer relationship management, stock information management and financial information management. At last, the paper conducted the adding and deleting test and stability test of the system data base. Based on the traditional sales mode, the application of the system to the automobile sales industry makes the whole procedure more convenient and systematic.

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Study on Multi-media Physical Education Based on Computer Platform

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Abstract: Multi-media network courseware is a learning platform based on multi-media website which applies a variety of modern media, including photograph, video, online music, flash, etc., to provide learners with all sorts of information resources and knowledge. Compared with education of other subjects, physical education is confined by many factors, including the size of sport venue, type of sport equipment, environment conditions and weather. Moreover, PE teachers are faced with great difficulty and heavy burden, which further constrains the development of sports education. That's why practical effect sometimes fails to be consistent with teaching theories. Based on ASP and other technologies, this paper analyzes the advantages and functions of multi-media network teaching platform and proposes the comprehensive structure and function model. By comparing two groups of experiment, this paper validates that multi-media teaching platform can facilitate physical education.

Keywords: Multi-Media; physical education; learning platform; ASP.

1. Introduction

As information network develops rapidly, remote education and online education have been quickly introduced into all subjects, including physical education for sure. (Tang, X., Luan, Z., Wu, N., Zhang, B., Jing, Y., Du, H., ... & Xu, S., 2015) Today, sports information has become an essential part of online resources. Therefore, a network environment which has never been seen in the history generates new developing potential for sports information. As an important module of higher education, sport courses are paid increasing attention. (Fang, S., Yang, C., Zhang, Y., Xue, C., Bi, H., Dai, H., & Xing, X., 2016) Some popular courses are often liked by so many students that some of them are unable to sign up. In traditional classroom teaching mode, teachers give lessons to students in a face-to-face, monodirectional manner under unified teaching schedules. Since this mode can no longer meet the demand of physical education today, remote online physical education comes into existence. Based on campus network, it has advantages of high interactivity and free of time and space constraint. It can thus transform traditional information transferring manners which include presentation, vision and sound into ones that can transfer information of more sorts via computer network or telecommunication network. In this way, physical education activities can be made into information transmission of many manifestation patterns including video,

audio, still images, text and flash, and so on. Remote network physical education platform can apply live web casting technologies to enable students to watch teaching contents in various places, thereby supplementing insufficient education resources (Wang, J., Chen, H., Li, Y., Wu, Y., & Zhang, Y., 2016).

Multi-media CAI (computer aided instruction) has emerged for a long time. As a tool for information processing, computer is highly regarded by education community. (Prieto, Á. E., & Lozano-Tello, A., 2014) Many educators have strived to apply computer to aid teaching. In 1959, the Auston research center of American corporation IBM designed the world's first computer teaching system. Thence, CAI has developed step by step. In Japan, Canada and Britain, CAI system was made available successively in the middle of the 1960s, the late 1970s and the early 1980s. The popularity and continuous development of computer technology accelerated the development of CAI. In 1970, Kapoor successfully created artificial CAI system, namely artificial intelligent computer aided education system. In January 1990, a MCAI system named Apple computer global education website was used across over 30 countries and regions. Students can transfer information and learn from each other via Internet. The PINE-NET system developed by Japan is a multi-media education network system designed for information processing technical personnel. MCAI conducts education activities mainly based on computer. They are also regarded as computer aided teaching activities (Choi, S. J., Kwon, M. K., Bae, S. Y., Kim, D. H., Choi, J. Y., Lee, J. H., & Byun, Y. S., 2015).

2. Main Technology Theories and Structure

2.1. ASP

ASP is Active Server Pages. It was put forward by the Microsoft Corporation to coordinate the development of Web technology and to build up interactive and dynamic web server program. Via ASP, Web pages can interact with users and make quick feedback. At present, ASP is widely applied in the message board and access statistics, and other relevant fields.

The workflow of ASP is shown in figure 1:

1. Enter to the client an address which points towards an ASP program of the server
2. By decoding, the browser establishes HTTP request and transfers it to the server.
3. The server obtains the request of the client. After radiation, the server performs ASP program.
4. Via ASP, the server establishes response message and sends it to the client.
5. The client accepts response message. The browser can decode to display the pages of coordinating code.

The working principle of ASP is: the browser sends application to Web server via HTTP protocol; the Web server responds to the application; the applied file is explained by ASP engine. If there are other modules, they are applied to explain the file jointly. For ASP script command, Web service will call the coordinating script engine. When dealing with the request to visit database, ADO can connect with database via ODBC, visit database and send the visiting results back to Web server. See Figure 2 for more details (Lafave, L., Tyminski, S., Riege, T., Hoy, D., & Dexter, B., 2016).

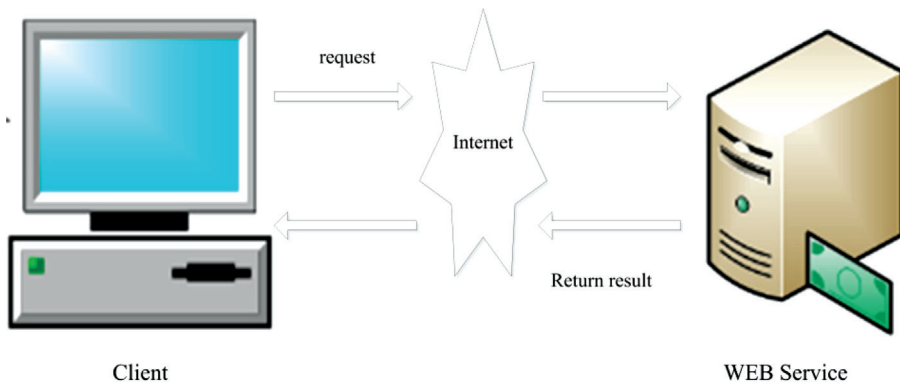


Figure 1 – ASP Workflow

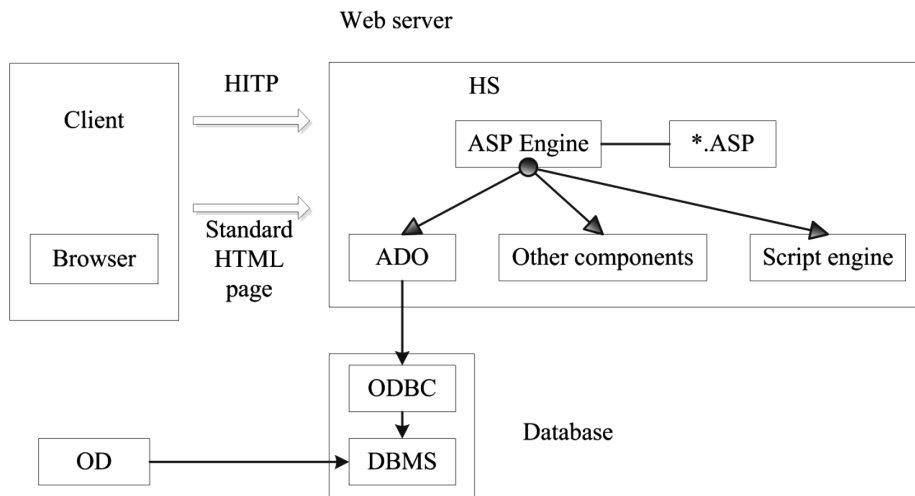


Figure 2 – ASP Working Principle

2.2. Establishment of Network Teaching Platform

B/S, namely Browser/Server, is a structure of browser and server. On the computer of users, only one browser is needed, like Internet Explorer; servers are database like oracle, Sybase, Informix or SQL. The browser exchanges data with database via Web Server. Users send applications to many servers distributed on the network via browser. The server processes the application from the browser and sends the information needed by users back to browsers. Promoted by AJAX, the programs of B/S structure can be partly processed on the client, thereby greatly reducing the burden of server and increasing interactivity. (Yıldırım, M. E., Kaynar, M., Ozyuvali, E., Badem, H., Cakmak, M., Kosem, B., & Cimentepe, E., 2016) The partial real-time refresh of B/S structure has a biggest advantage. Only one terminal (computer, pad or mobile phone) enables users to directly visit system at any places without client or maintenance, thereby greatly reducing financial and manpower cost. Meantime,

the system can be extended. Its workflow is: users open browser and enter website address, use server to obtain and accept request, apply business logic to cope with the request and visit database server, generate and send back coordinating results. Thence, users can visit web pages for which they are searching. In this process, application server plays a leading role. It can perform many key tasks like sending data application, dealing with request, sending back results and visiting database (Najarzadeh, R., & Shahidi, A., 2015).

2.3. Making Technology

FrontPage belongs to Office software kit. Users who are familiar with Word can use FrontPage with ease (Hanauer, M., Perentes, J. Y., Krueger, T., Ris, H. B., Bize, P., Schmidt, S., & Gonzalez, M., 2016). FrontPage is a practical webpage making software, for it is easy to operate. Multi-media network teaching platform maintainers and PE teachers in colleges and universities can establish physical education websites without much effort (Y dayan, V., Soca, G., & Cura, L., 2016).

Dreamweaver contains visualized editing, software package of HTML code editing. It supports features like ActiveX, JavaScript, Java, Flash and Shockware. In addition, it can make animated HTML flash by drawing the object from the start to the end. Hence it can help enrich the content of sport courses.

Flash is the image or animation designed specifically for webpages. It mainly includes vectorgraph; but it also has imported bitmap and sound effect. By connecting the information entered by the audience, it can make interactive movie to generate interactive effect. Flash can interact with other Web program. In the design of sport courses, Flash can be used to create animated LOGOS and animated features with synchronous sound effect, and to make complete and sensitive web pages. Meantime, Flash movie is made up by condensed vectorgraphs. Therefore, Flash movie can be quickly downloaded and watched by many people.

Since Flash uses vectorgraphs to make animation and movie, it cannot achieve real action effect. Therefore, we need three-dimensional animation to dissect and analyze the action in sport courses in detail. There are many three-dimensional making software which are available, such as 3DMAX, MAYA, SOFTIMAGE, and so on. They can be used to make three-dimensional effect and replicate people, equipment and scene in three dimensions. Through the shift of elements and scenes, all technical movements in sports can be simulated. These animations can be used for demonstration in lessons. They can even make up for some insufficiency of the demonstration of real people. Virtual reality is a computer multi-media technology which can make a series of photos into three-dimensional objects and panoramic image by special means. When watching virtual real objects on the computer, people can have the object spin by only pushing it via mouse, just like holding the real object on their hand. The object can be observed at their will. Virtual reality can demonstrate the actions in sport technical classes in detail. For example, students can observe the same gesture at different angles to master this action (Osborne, S. N., Schmidt, M. A., & Harper, J. R., 2016).

3. Function and Application of Multi-Media Network Teaching Platform

3.1. Sports Information Resources

The main function of the module of sports information resources is to integrate the latest sports information resources. Via Computer Robot, it can search a variety of sports information websites for the latest sports information and resources, and launch all the information in this module so that students and teachers can obtain the latest sports information and resources. College students and teacher can master the latest news in sports via this module. They can also watch the videos of all kinds of grand sport event. As for colleges, they can use this module to launch the latest sport information in the campus. Take basketball as an example, students can watch basketball related information as soon as they can.

Basketball News

NBA: Curry nets 22 points as Warriors take 2-0 series lead

Top-seeded Golden State Warriors hosting the New Orleans Pelicans in Game Two of their Western Conference series, and MVP candidate Steph Curry would look to help the home team take a 2-0 lead.



NBA: Celtics lock up seventh seed in the East

The Atlantic Division champion Toronto Raptors traveled to face the Boston Celtics yesterday. A win for the playoff bound Celtics would lock up the seventh seed in the Eastern Conference as Beantown makes their first postseason appearance since they traded Paul Pierce and Kevin Garnett to the Brooklyn Nets in 2013.



Harden has 30 to help Rockets over Pelicans 121-114

In the NBA, the Houston Rockets had slipped to sixth place in the West after losing back-to-back games, and were desperate to avoid a third straight defeat as they hosted the New Orleans Pelicans



NBA: Curry sets record for most 3-pointers in season

Steph Curry was looking to re-write the NBA history books.



NBA: Randolph leads Grizzlies past Pelicans

In the NBA, the New Orleans Pelicans were looking to put some space between themselves and the Oklahoma City Thunder, after overtaking OKC for the eighth and final playoff position in the Western Conference.



Figure 3 – Sports News Module

3.2. Physical Education

This module is the core of college physical education multi-media teaching platform. Its major function is to demonstrate and aid the PE teaching in colleges. (Zawila-

Niedźwiecki, J., 2015) In this module, there are sub modules including course introductions, electronic textbooks, teaching plans, multi-media network courseware, live teaching, videos of classes (with excellent courses included), collection of course resources, etc. Via this module, teachers can edit and launch the information resources of their courses. Students can learn more about sports courses and learn by themselves. Under the assistance of multi-media network courseware, students can watch the video of technical movements at high level of complexity in order to master actions. For schools which have scarce physical education resources, they can learn sports courses by watching the live teaching in this sub module. For instance, they can repeatedly watch the key gestures in the video and also download the video to learn by themselves (Bai, M., Chen, X., Wu, J., Liu, G., Chen, Y., Chen, H., & Li, Q., 2016).

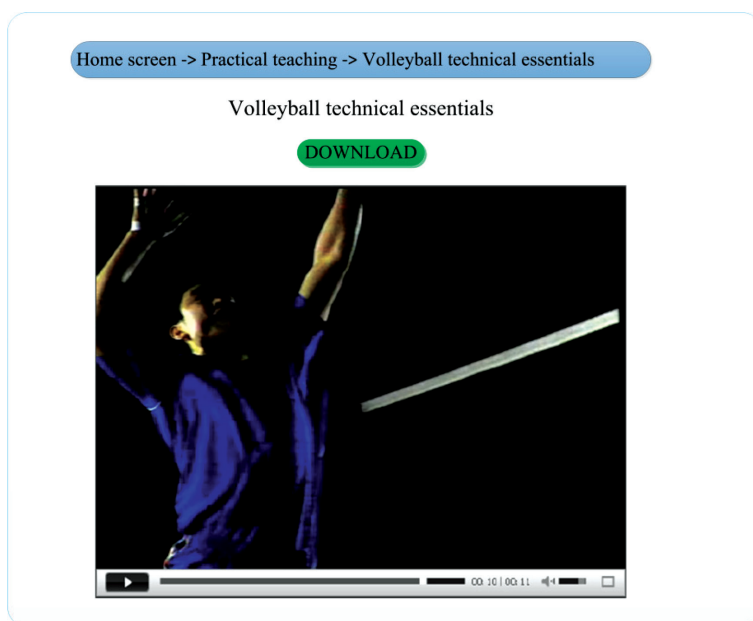


Figure 4 – Volleyball Technical Teaching Video

3.3. Online Classroom Teaching

Online classroom teaching lays emphasis on sport techniques and theoretical knowledge which students can learn on their own. It can directly replace the face-to-face teaching between teachers and students, thereby facilitating independent learning. By uploading these teaching contents onto internet, students can select courses at their own will.

Generally speaking, complete online teaching process includes demonstration, explanation, essentials of action, teaching methods, mistakes and corrections, theoretical knowledge, and so forth. Online classroom education can effectively reduce the pressure of teachers. After the online class, students can evaluate the courses for teachers' improvement.

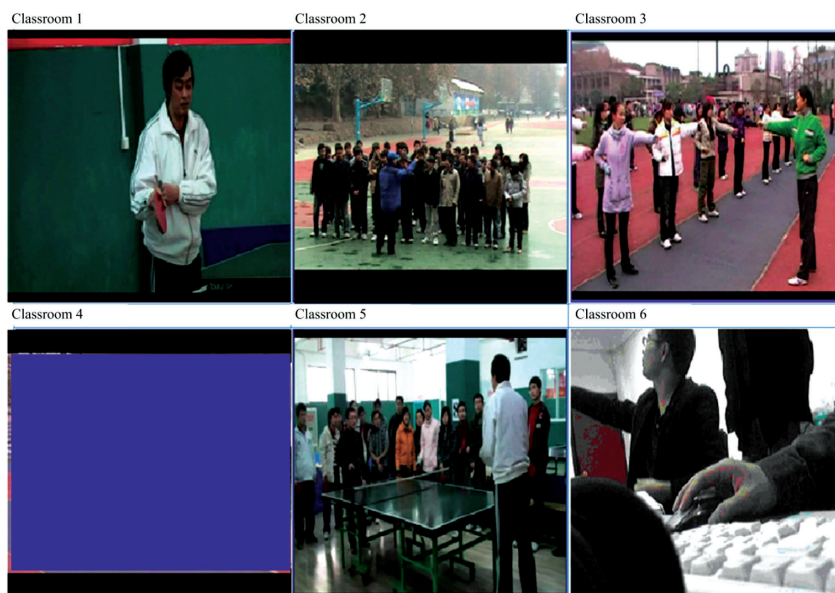


Figure 5 – Select Classroom

Students can make full use of extracurricular time to learn and practice the knowledge which they learn from network. Online classroom teaching is a special feature of applying multi-media education. These students can be fully proactive when learning on their own. Teaching contents are presented in a non-linear manner, and abundant chances of interactive learning between computer and students are provided. In this way, students can choose their learning contents and make learning schedule on their own.

4. Analysis of Teaching Effects

To validate the teaching effect of multi-media platform, this paper conducts a comparative experiment, using volleyball as an example. Students are divided into two groups: control group and experimental group. Students in control group are taught in traditional mode; those in experimental group are taught with the assistance of multi-media platform. But the two groups own the same teacher. Their teaching venue, contents and schedule are the same. Students of the two groups are both learning as usual. They are not informed of this experiment for fear that they would have been mentally affected. If so, the effect of this experiment will also be influenced.

The two groups both learn volleyball spike technique under the same teaching schedule and with the same method. But experimental group uses multi-media network teaching additionally. The following is the detailed teaching process:

1. Online preview: before the class, students in the experimental group log in online multi-media volleyball teaching system to learn theoretical knowledge including technical concept, movement analysis, classification and common

mistakes explanation, and big events of volleyball, teaching video, video of detailed technical movement and teaching photographs during their extracurricular time, so that they can have primary understanding on what they are going to learn.

2. Classroom learning: during the class, the teacher first make oral interpretation of knowledge related to spike technique, of the significance of spike in competition, and of the features of spike. Then, he performs some movement demonstration so that students can have the concept of the whole spike movement. At last, he explains and demonstrates every movement structure of spike technique to students and arranges exercises. When doing practice, students' movements are recorded and photographed.

The results are shown as follows.



Figure 6 – The Students in the Experimental Group the Spiking Skill

Different from the experimental group, the control group does not use multi-media aided teaching system. Without online communication in extracurricular time, the control group applies the same teaching procedure, practice methods and time just the same as the experimental group. The results are shown as follows:

Group	Number	>90	90-80	80-70	70-60	<60
<i>Experience group</i>	20	4	10	5	1	0
	Percentage	20	50	25	5	0
<i>Comparison group</i>	20	2	6	5	5	2
	Percentage	10	30	25	25	10

Table 1 – The Students of Volleyball Technology Theory Knowledge Test Scores

Group	Number	Excellent	Good	Pass	Fail
<i>Experience group</i>	20	8	10	2	0
	Percentage	40	50	10	0
<i>Comparison group</i>	20	3	6	9	2
	Percentage	15	30	45	10

Table 2 – The Students of Volleyball Skill Examination Scores

In the experimental group, there are 40% students who get excellent scores, 50% who get good and 10% who just pass the test. As for control group, only 15% students are excellent, 30% are good, 45% narrowly pass and 10% fail to pass the test. Obviously, the score of experimental group is higher than control group. The difference between the two groups is quite big. It is thus logical to conclude that multi-media aided teaching has quite good effect in practical teaching. Meantime, it is highly recognized and evaluated by students.

5. Conclusion

Multi-media courseware and network can provide abundant enough learning resources to students so as to enlarge their knowledge. Network information resources are rich and varied, including gymnastic courses, courseware, photograph, audio, teaching plan, exercise, simulated experiment, gymnastic technical movement, video of competition, live broadcast of sport events, theoretical knowledge, and so on. It provides us a convenient, fast and economical way to share teaching resources. Both college students and learners from all social classes can use the teaching video and courseware made by excellent teachers without the constraint of space and time. They can conduct interactive learning freely and obtain abundant teaching information and contents in short time. Computer can automatically analyze students' learning conditions' thereby offering different learning plans to students at different levels. Multi-media network

teaching platform has strong interactivity. Through applying real-time communication technology of modern computer network technology and online camera, the platform can make live broadcast of physical education. This technology can achieve remote face-to-face talk so as to solve potential problems in the course of learning in a direct way.

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Comprehensive Energy Saving Model Design of New Residential Construction in Rural Areas of Hebei Province

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Abstract: Along with the comprehensive advancement of Socialism New Countryside Construction and the in-depth development of energy-conservation and emission- reduction in China, the energy conservation and the sustainable development of rural housing has already become a very important and urgent question. The paper writer investigates and researches on energy saving of rural houses in Hebei Province. Combined with the climate features in this region, the essay systematically studied the rural residential energy-saving technologies such as the residential location and orientation, energy saving design of enclosure structure, passive technique of heating and lowering temperature. In this paper, the design of energy-saving model room is completed and the energy-saving technology was simulated through establishing energy consumption calculation model in energy analysis software DeST-h. The energy-saving effect of energy-saving technology has been discussed and the optimal scheme is obtained. The purpose of this study is to reduce the energy consumption and improve the indoor thermal environment of rural residence, which provides a reference for the energy saving design of rural residential buildings in Hebei Province in the future.

Keywords: New residential construction; rural housing; energy-saving technology; model; building envelope.

1. Introduction

With the development of the rural economy in Hebei Province, the requirements for the living conditions of peasants gradually increase, heating and air conditioning equipment will also become more and more popular, but there is no energy saving measures in the current rural housing in Hebei province and the insulation performance of envelopes is low, so it will definitely increase resource consumption, which runs counter to national development strategies such as construction of new countryside and sustainable development. Therefore, the most important task of new rural construction in Hebei province is to improve the thermal insulation performance of rural residential building envelope, to reduce residential energy consumption and improve the thermal comfort of residential building. Building energy consumption occupies a larger proportion in energy consumption all over the world. Since the energy crisis in the 1970s, building energy conservation has been gradually obtained the people's attention. All the countries

in the world (especially the United States, Germany, Britain and Japan) invested a lot of manpower, material and financial resources in the building energy conservation. They did in-depth study on building energy conservation, adjusted measures to local conditions, formulated a series of technical code for building energy-saving and policies and regulations. Through updating the building energy-saving technology and the implementation of energy conservation standards, they have achieved good effect in energy saving (Yue, F., Chen, K. L., & Lu, F., 2016).

Building energy saving work started late in our country. With the development of China's new socialist countryside construction, the relevant government departments and research institutes began to pay attention to rural residential energy conservation. They carried out a lot of research on rural residential energy saving. Zhu and others introduced an optimal design strategy which combined the new rural residential programs and energy saving technology (Lu, S. M., 2016). Wang and others analyzed the technical and economical efficiency of the active and passive solar energy combining heating system in the rural residential areas in the cold area (Wang, H., Cai, W., Wang, Y., Yan, J., & Wang, L., 2016). Zhang diagnosed the thermal insulation performance in the rural housing in northern Shaanxi area, and he designed a composite wall by using finite element method to make one-dimensional steady-state heat transfer calculation on the heat preservation and thermal insulation of a variety of walls which can be used in the north of Shaanxi Province (Yao, J., Li, B., Kong, X., & Zhou, F., 2016). Xu analyzed the cultural adaptation and climate adaptation of roof of the rural residential, and put forward the appropriate roof sunshade heat measures and double-layer composite thermal insulation roof (Chang, X. F., Luukkonen, A., Olson, J., & Beatson, R., 2016). Residential energy saving technology in rural areas mostly stay in the demonstration stage. It is a problem worthy of study that how to make energy saving technology enter ordinary rural families and be accepted and used by farmers. This paper uses the questionnaire survey method for field data collection. After the data analysis, energy-saving technology and the housing model was simulated by means of building environment and HVAC system simulation software DeST-h to test research results of energy saving effect. This study will help promote the healthy development of rural housing in Hebei Province, reduce environmental pollution, reduce the demand for non-renewable resources in rural residence, improve the comfort of rural residence and improve the living standards of farmers (Prieto, Á. E., & Lozano-Tello, A., 2014).

2. Investigation and Analysis of Rural Housing in Hebei Province

2.1. Status Quo of Rural Residence in Hebei Province

Rural residences in Hebei Province are relatively simple and plain. The principal room plane has been in use traditional 3 bays or 5 bays form. Most of the residence is also equipped with the east and west wings in addition to the principal room, and there is still a small part of buildings have a south room. Each bay of the principal room is around 3.3m ~ 3.6m, into the deep at around 4.8m~ 6m. The central room is in the middle of the principal room, with functions of the living room and dining room. The east and west sides of the principal room are the bedrooms, which are united by the principal room and it also functions as storage room. The wing has generally 2 or 3 rooms, where one of the wing bays is used for the kitchen and the rest is mostly storage space for food and other items. The setting of toilet is more flexible in farm house. It is generally set in

the corner of the yard, such as northwest, northeast and southwest corners. Because the toilets are dry pail latrines in rural areas which are not clean and smelly, some farmers directly set the toilet outside the yard, which is very inconvenient to use. In the case of the homestead area, the farmers would build other housing according to their own needs. Farm house generally is set a gate as the entrance and the courtyard is mostly set in the southeast corner. In order to make the yard toward the road accessible or affected by the homestead, the gate is arranged in the northwest or southwest corner sometimes. The yard would usually be set fuel storage space for breeding, agricultural implements and firewood and other some farmers would use yard for compound planting. Overall, the rural residence has problems such as scattered layout, unreasonable arrangement, rooms are used randomly and debris are piled up in the yard, which looks chaotic.

2.2. Problems in Energy Saving of Rural Residence in Hebei Province

Through the questionnaire survey, we found that the main energy saving problem in the rural residential areas in Hebei Province is the high energy consumption in heating. *Thermal Design Code for Civil Buildings* provides the heat consumption indexes calculating formula:

$$q_H = q_{H.T} + q_{INF} - q_{I.H} = (t_i - t_e) \left(\sum_{i=1}^m \varepsilon_i \cdot K_i \cdot F_i \right) / A_o + (t_i - t_e) (C_p \cdot \rho \cdot N \cdot V) / A_o - q_{IH} \quad (1)$$

$q_{H.T}$ — Envelop Heat Transfer Value,

q_{INF} — cold air infiltration per unit construction area,

$q_{I.H}$ —Heat in the interior of a building per unit construction area, (residence building in this case : 3.80 W / m² (Kim, H., Shin, S., Jung, H., Kim, J. O., & Cha, J., 2015)),

t_i — Average room temperature, (16 °C in this case),

t_e —Average outdoor temperature during heating period, (1.2 °C (Xu, J., & El Mansori, M., 2016) in this case),

ε_i —Correction coefficient of heat transfer coefficient of building envelope,

K_i —Heat transfer coefficient of building envelope (W / (m² · K)),

F_i —Heat transfer area of enclosure structure (m²),

A_o —construction area (m²),

C_p —Specific heat capacity of air, (0.28 W · h / (kg · K) in this case),

ρ —Air density (kg / m³), Value of t_e condition,

N — Ventilation frequency, (0.5 times / h in this case),

V —Ventilation volume (m³).

Calculation can be drawn that residential heat consumption index is 76.58 W/ m², which is 5.47 time that of heat consumption in urban residence (14.0 W / m² (Sajadi, B., & Baniassadi, A. B., 2015)). Thus we can see that the residential heating energy consumption is quite high in rural areas of Hebei Province, rural residential building energy conservation is imperative. From each enclosure structure heat loss ratio, the

roof occupies 47.66% and wall accounts for 38.43%, ground accounts for 8.07%, doors and windows accounts for by 5.83%, which is obvious to find that we must proceed from improving the thermal performance of the roof and wall in order to improve the rural residential heating energy consumption..

In addition, the rural residential buildings in Hebei province also have problems such as the oversimplified structure, poor thermal insulation performance of enclosure structure, low acceptability of new building materials, weak awareness of energy conservation, low utilization of solar energy and so on.

3. Key Techniques and Modeling Methods in the Design of Integrated Energy Saving Model

3.1. Calculation Methods of Residential Location and Orientation

In the process of determining the best orientation of Hebei Province housing, the following two aspects should be taken into consideration: the first is the residence can obtain more sunlight in winter, so as to guarantee the indoor comfort, while avoiding the summer sunlight directly injecting into the room; the second is to ensure to avoid the winter cold wind, as well as to maintain good indoor ventilation in summer. In the process of determining the best direction, we must first consider the heating needs in winter to select the scope of best direction, and then determine the best direction according to the wind direction (Liu, P., 2015). In this study, according to the data of solar radiation in Hebei Province, the meteorological data of major cities in Hebei province were analyzed by using Tool Weather tool in Autodesk Ecotect Analysis software.

3.2. Sharp Coefficient Calculation

Assume that the total bay length of a rural house is A, the depth is B, the height is H, its shape coefficient is:

$$S = F_o / V_o = (AB + 2AH + 2BH) / ABH = 1 / H + 2 / B + 2 / A \quad (2)$$

3.3. Design Method of Lighting and Shading

Ecotect, developed by Square One, is a comprehensive aided-design software for technical performance analysis. It uses a visual modeling method to make thermal analysis, sunshine analysis, acoustic analysis and lighting analysis through loading the meteorological data of an area. The calculation results are accurate and intuitive. In this paper, the Ecotect software is used to analyze the situation of the lighting and shading of the rural residential buildings in Hebei province.

3.4. Energy Consumption Simulation Method

DeST is the abbreviation of Designer's Simulation Toolkit., it is the crystallization of scientific researches of Tsinghua University Construction Science and Technology

Department of building environment and equipment for more than a dozen years. It is a software platform applied in the design of the building thermal environment simulation analysis [J].

DeST has the following characteristics: using the natural room temperature as a bridge, to connect buildings and environment control system; sub-stage design, sub-stage simulation; ideal control concept; graphical interface, a high degree of visualization; platform has universal type. DeST-h (residential building thermal environment simulation toolkit) is a version of DeST dedicated to the analysis of residential building thermal environment, is a functional software located in the service of residential simulation and related performance. As a derivative software of DeST, DeST-h has all essential features of DeST, it also has some unique characteristics: to analyze the main residential energy conservation, evaluate thermal environment of residential building, optimize the general energy system for residential buildings etc. (Zhao, Y., Wu, J., Yang, H., & Yan, S., 2016). Because of DeST-h has the advantages such as simple operation, high visualization degree and high calculation precision like DeST, it also has function to make residential energy simulation analysis, so this paper adopts DeST-h to do research.

4. Design of Energy Saving Model Room for New Rural Residence

4.1. Rural Residential Planning and Layout

Through the simulation by Ecotect, we can find that best direction of rural residence in Hebei province is south-southeast 15 degrees (Figure 1), which not only can guarantee that the housing can obtain more solar radiation in winter, but also can avoid too much solar radiation entering the room in summer; at the same time the direction can also avoid dominant wind direction of this area in winter (NNW), ensure the angle of projection to the dominant wind direction in summer is less than 15 degrees.

Due to the low layer and shallow depth, the shape coefficient of rural residence is relatively large, which is not conducive to energy conservation. The residence in this area should adopt two-storied house which is 10 m * 10 m and 3.3 m height, which can effectively control the shape coefficient around 0.55. Multifamily parallel method can be adopted to further reduce the shape coefficient of residence. Through the reasonable partition of the plane, the main rooms direct south and the subsidiary rooms direct north or west. The subsidiary rooms can become a temperature damping zone of main rooms and the external atmospheric to reduce the adverse effects of energy consumption in main rooms due to the external climate change.

4.2. Building Envelope Energy Saving Technology

Energy-saving technologies of residential building envelope structure focus on two aspects: heat proof in summer and cold proof in winter. It improves the heat insulation performance of materials and the air tightness of doors and windows, and puts forward the technical measures for energy saving from the material and structure. Grass brick, as a rich source of green building materials, has excellent thermal performance (Figure 2). Residence built with grass brick can greatly reduce energy consumption; affected by

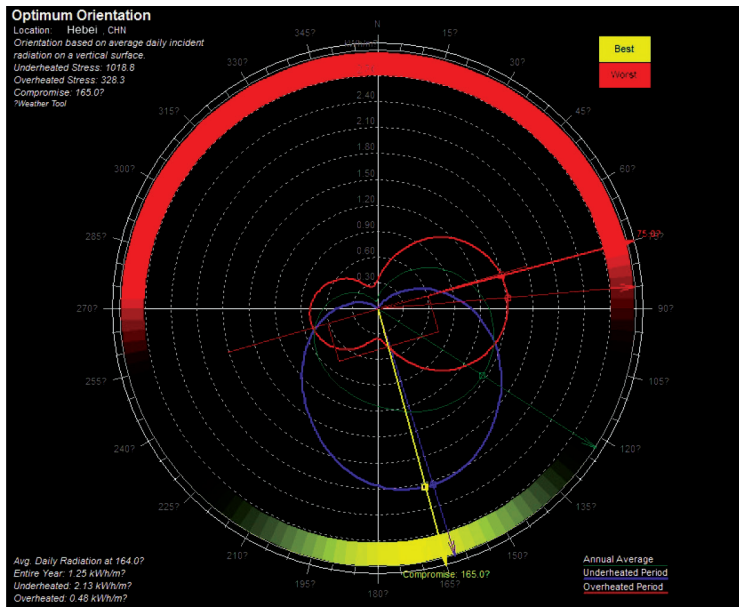


Figure 1 – Best Toward Analysis of Hebei Province.

farmers' intrinsic thoughts, it is not easy to extend and use grass brick house in rural areas, in addition, farmers is lack of the corresponding construction technology (Kim, E. K., Lee, K. K., & Cho, K. H., 2015). Therefore, it is necessary to increase the promotion and publicity, and to do a good job in training of straw brick construction technology and on-site guidance work.

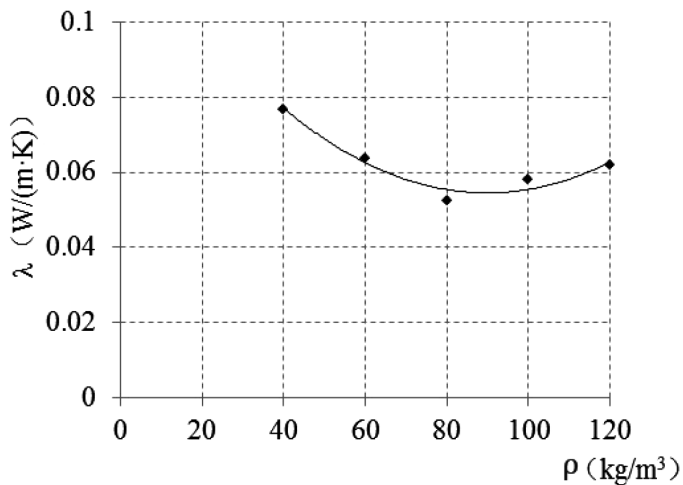


Figure 2 – The Relationship Between Thermal Conductivity (λ) and Density (ρ) of Straw Bales.

4.3. Passive Technique of Heating and Lowering Temperature

Passive heating and sunshine room can make use of solar radiation effectively, greatly reduce the energy consumption of heating in winter. At the same, the heating and sunshine room and the house should be ventilated by thermal pressure and wind pressure in summer to avoid increase of air-conditioning energy consumption due to poor ventilation (YAMAMOTO, T., 2015). As a kind of solar energy utilization technology, passive solar heating technology make the building absorb and transfer heat to the indoor as much as possible in winter days through the reasonable layout of the residence, appropriate choice of the enclosure structure materials and construction. It improves the indoor thermal environment. This method has simple structure, obvious energy saving effect and low cost, which can be widely applied in rural areas. In accordance with the way to gain heat, passive solar heating technology can be divided into direct heat gain type (Figure 3A) and indirect heat gain type (Figure 3B and C)

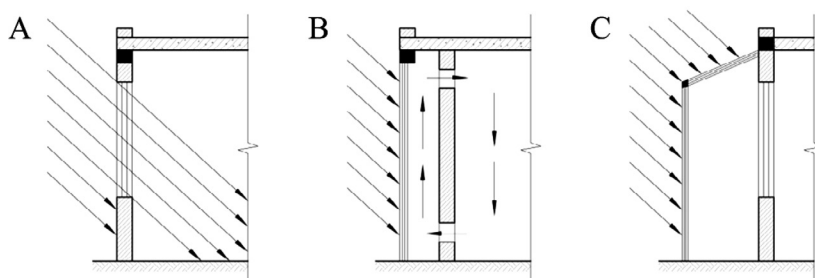


Figure 3 – Classification of Passive Solar Heating Technology. A, Direct Heat Gain Type; B, Solar Thermal Storage Wall; C, Heating of the Sun Room.

Residential ventilation plays a very important role in improving the indoor thermal environment. When there is a pressure difference between the indoor and outdoor air, the natural ventilation of the house can be formed (Jedidi, H., Depierreux, F., Jedidi, Z., & Beckers, A., 2015). According to the reason of the pressure difference, the natural ventilation can be divided into thermal natural ventilation and natural ventilation by wind pressure (Figure 4).

Sun-shading design is simulated and calculated by Ecotect. Through the software retrieval of geographical location and meteorological data of Hebei Province, the horizontal shading design and overall shading design are completed according to the sun's orbit in July in this area (Roman, K. K., O'Brien, T., Alvey, J. B., & Woo, O., 2016). The horizontal shade and overall shade drawn by Ecotect are shown in Figure 5 (bold black line box). The horizontal shade is 328 mm x 5354 mm, the length is far more than the bays, so horizontal shading design is not suitable for Hebei area; the overall shade is 277 mm x 1500 mm, this scale is more reasonable, so it is suitable for Hebei area to adopt overall shade. By the scale of the overall shade, it can greatly reduce the solar radiation heat which directly injects into the indoor in the hottest month, and it can reduce the energy consumption of air conditioning.

The window-wall ratio of the residence in this area should be controlled in 0.2 ~ 0.3, this can not only meet the lighting requirements, but also can reduce the requirement of thermal performance of windows; when selecting window shape, the residential flat should be taken into consideration, the wide and shallow rooms should match the

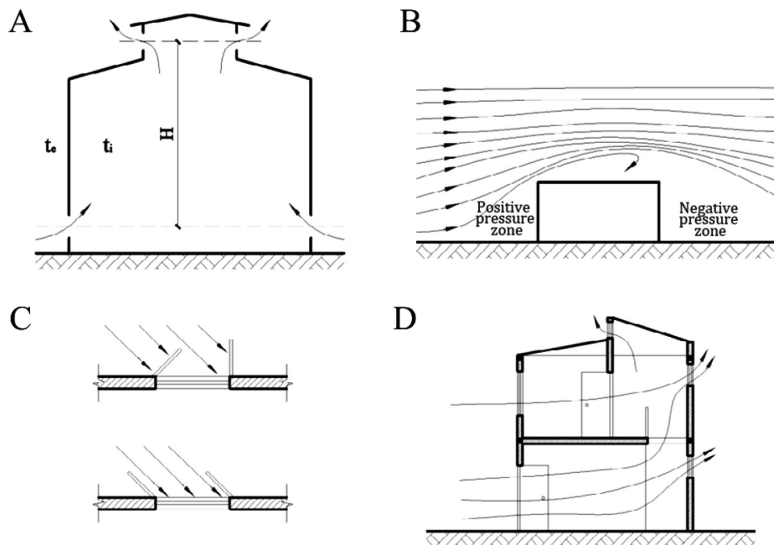


Figure 4 – Natural Ventilation. A, Natural Ventilation Caused by Temperature Gap; B, Positive and Negative Pressure Area Caused by the Wind; C, The Casement of Wind Prevent and Wind Guide; D, Hot Pressing Ventilation of Double Residential.

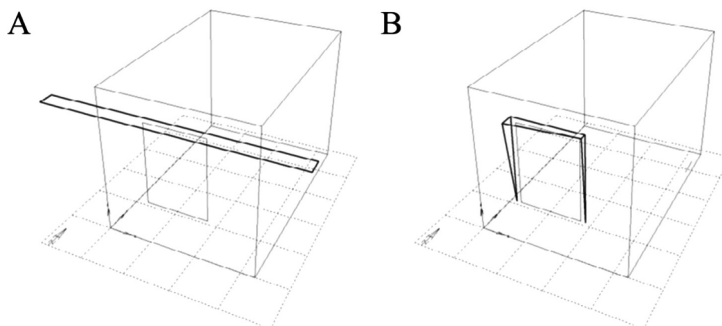


Figure 5 – Rectangular and Surrounding Shade Draw by Ecotect. A, Rectangular Shade Draw; B, Surrounding Shade Draw.

horizontal rectangular windows, narrow and deep rooms should match the vertical rectangle windows, so that the indoor lighting uniformity is better (Danza, L., Barozzi, B., Belussi, L., Meroni, I., & Salamone, F., 2016); The uniformity of one-side lighting is poor, high side window can be added to improve room lighting uniformity; the width of heating room with opaque eave or roof should be no less than 1.5m, otherwise it would affect the indoor lighting and increase lighting energy consumption.

According to the economic capacity and usage habits of the rural areas, the scheme adopts form of two- storied residence, the residential area is 100.98 m² and total construction area is 158.94 m²; the two-storied residence can reduce residential shape coefficient and increase the courtyard area. Scheme 3 uses conventional the three bays in rural

areas, which increase the depth of the housing. Through the reasonable arrangement of the partition function, the plane is more concentrated. Considering that agricultural implements are widely used in this area, the scheme adds agricultural implements storage to avoid them being piled up at random in the courtyard, which is likely to affect the courtyard neat, at the same time, to avoid the rain erosion of agricultural implements; considering that farmers have the habit of family breeding and planting, it sets the breeding area and the planting area (Figure 6).

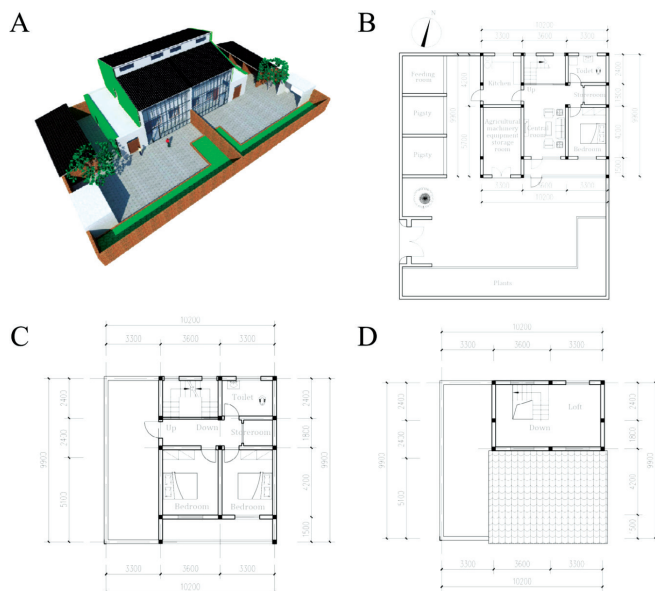


Figure 6 – Rural Residential Energy Conservation Program. A, The Foundine Plan; B, The First Floor Plan; C, The Second Floor Plan; D, The Plan of Loft.

Compared with the traditional rural residence, the proposed scheme has the following improvements: (1) the centralized distribution of functional areas. Compared with the traditional residential layout, the centralized layout can effectively reduce the sharp coefficient of the residential building, while it is convenient to go through the various functional areas. (2) It increases the building depth. The depth of the residence in this scheme is up to 9.9m, compared with traditional building which is less than 6m depth, large depth helps reduce the shape coefficient of residence. (3) It reduces the building height. At present, the residential floor height in Hebei area is about 3.9m while the floor height of the residence in this scheme is 3.3m. Using a lower floor height can reduce the cost and energy consumption. (4) Using the storage space, bathroom, kitchen and other rooms with auxiliary functions to surround the main function room, forming temperature damping area to weaken the influence of the external climate in the indoor thermal environment. (5) Adding heating sunshine room to increase the comfort degree of bedroom and central room in winter, and to benefit the thermal pressure ventilation in the summer by opening of the top window of the sunshine room. (6) The appropriate window-wall ratio. The window- wall ratio is 0.25 and 0.23, which is bigger than that of

the traditional rural residence and smaller than that of the new rural residence, which can not only meet the lighting of the room, but also reduce the energy consumption of the house. (7) The addition of attic. It is convenient to store sundries and can be used as temperature damping space of the roof; at the same time, staggered arrangement of the roofs of fore slope and back slope is conducive to the ventilation and lighting of attic. An additional insulation ceiling is set under the roof of the fore slope to reduce the heat loss in winter.

5. System Performance Test

5.1. Composite Simulation of Retaining Structure

Composite retaining structure schemes are shown as below:

Envelop enclosure	Program 1	Program 2	Program 3
<i>Roof</i>	Roof 1	Roof 1	Roof 2
<i>External wall</i>	Wall 1	Wall 2	Wall 3
<i>External window</i>	Window 1	Window 2	Window 1
<i>Door</i>	Default settings of DeST-h		

Table 1 – Composite Retaining Structure Scheme.

In consideration of the energy-saving transformation in existing residence, scheme 1 adopts self-bearing brick-concrete structure, the construction technology is mature. It uses polystyrene board as insulation materials and has excellent thermal insulation performance, the overall price is high; the aerated concrete block in scheme 2 is selected according to the new masonry which is extended to use in Hebei province. This scheme adopts the frame structure, it does not need to a thermal insulation layer, the construction is simple and quick, it has good insulation effect and a moderate price; scheme 3 is selected according to the actual situation in rural areas which have rich straw resources, it has demonstration project in our country, this scheme adopts light steel frame structure, the straw bricks are filled in the frame. The roof adopts straw insulation layer. The construction is convenient and it has good insulation effect and low price, which is suitable for extension in rural areas.

The building model is built with DeST-h, and the building envelope materials of different schemes are input. The computer simulation results are shown in the following table:

From the simulation results, the three schemes have relatively good energy saving effect. Due to the heat transfer coefficient of grass brick is much lower than that of scheme 1 and scheme 2, the annual total load of scheme 3 is far lower than that of the reference building and the other two schemes; the energy consumption in scheme 1 and scheme 2 is higher than the reference building, which does not meet the standard requirements. On the one hand it is because its thermal performance of the building envelope is lower than the reference building, on the other hand, it is because the shape coefficient of the design building is relatively high and the heat radiation area of the outer enclosure is larger, so the energy consumption is higher.

Index	Program 1	Program 2	Program 3	Reference building
Air conditioning area	61.92	61.92	61.92	61.92
Annual total heating load index ($\text{kW} \cdot \text{h} / \text{m}^2$)	46.08	47.06	34.06	46.53
Annual total cooling load index ($\text{kW} \cdot \text{h} / \text{m}^2$)	16.22	17.36	15.20	15.67
Annual cumulative total load index ($\text{kW} \cdot \text{h} / \text{m}^2$)	62.29	64.42	49.27	62.20
Annual cumulative total load energy saving rate	37.77%	35.64%	50.77%	37.86%

Table 2 – The Results of Simulation of Energy Consumption.

5.2. Feasibility Analysis

Economic input is the primary factor in the new residential construction of farmers, it is also the key factor in the program selection. Therefore, it is necessary to analyze the economics of the three schemes, and to discuss the economic acceptability of different energy saving housing schemes. According to the characteristics of energy saving technology measures of the three schemes, the cost table of enclosure structure technology is established by looking up the information and combining with the actual situation of the investment in the construction of the countryside. Combined with the technical feasibility analysis of the external envelope, the comparison table of the comprehensive factors of each scheme is available (Table 3).

Index	Original house	Program 1	Program 2	Program 3
Cost	High	High	Very high	Moderate
Energy conservation	Poor	Good	Good	Good
Comfort level	Poor	Good	Good	Good
Fireproofing	Good	Good	Good	Good
Earthquake Resistance	General	General	Good	Very high
Durability	Good	Good	Very high	Good

Table 3 – Comparison of Comprehensive Factors of Each Scheme.

From table 3, it can be found that the residential building used of clay brick is not only high cost, but also poor thermal insulation performance and comfort degree, it is discouraged in the actual construction. In these three energy-saving residence schemes, the scheme 3 has good energy saving performance, comfort degree and seismic performance, and it has lowest cost, the small environmental load. The scheme 2 has good energy saving performance, good durability, and long service life, but the cost is high, the acceptability in the rural area is low, and it is not easy to deal with the construction waste. The scheme 1 overcomes the shortcomings of the traditional residential energy-saving insulation performance. At the same time, the cost is not relatively low. It has wide range of application because the energy-saving technology can be not only used for the new

house, it can also be used for the energy saving transformation of the existing residential buildings. Compared with the traditional rural housing, scheme 3 can be referred to as the “high-performance residence with low cost”, but its comprehensive acceptability is not high due to restriction of farmers’ intrinsic thought; scheme 2 can be referred to as the “high-performance residence with high cost”, it is not suitable for extending and using in rural areas; scheme 1 is in the intermediate level, its comprehensive acceptability in the rural is relatively high. It can be used in the transition stage from existing residence to the scheme 3.

6. Conclusion

Along with the comprehensive advancement of Socialist New Countryside Construction and the in-depth development of energy-conservation and emission-reduction in China, the energy conservation and the sustainable development of rural housing has already become a very important and urgent question. The paper writer investigates and researches on energy saving of rural houses in Hebei Province. Combined with the climate features in this region, the essay systematically studied the rural residential energy-saving technologies such as the residential location and orientation, energy saving design of enclosure structure, passive technique of heating and lowering temperature. In this paper, the design of energy-saving model room is completed and the energy-saving technology was simulated through establishing energy consumption calculation model in energy analysis software DeST-h. The energy-saving effect of energy-saving technology has been discussed and the optimal scheme is obtained. It provides a basis for the rural residential building envelope energy saving technology in Hebei province and it has guiding significance in the design of rural housing in Hebei province.

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Network Reliability Study Based on Analytic Hierarchy Process (AHP)

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Abstract: As the Internet information technology is widely applied, it has been used in varied sectors to support data transmission and information processing. In order to ensure the security of data transmission, network reliability has been paid great attention to. As network reliability is mainly influenced by transport protocol, a detailed analysis is needed to reduce its negative effects, during which analytic hierarchy process (AHP) is a good way. This study analyses factors which can influence network reliability based on AHP, and concludes that the network reliability mode based on AHP will promote network construction through a contrastive analysis between the application mode of AHP and calculation.

Keywords: Computer network; reliability, analytic hierarchy process (AHP).

1. Introduction

As the Internet information technology is widely applied, it has been used in varied sectors to support data transmission and information processing. However, when network works, network reliability is a hidden danger for network communication and other network actions. At the same time, network failure will block normal applications. Therefore, establishing a completed network reliability system and solving network problems are focuses of computer network technology (Balouchi, M., & Khanmohammadi, E., 2015).

Currently, common computer networking technologies include frame relay technology, digital data network technology, broadband technology and wireless networking technology (Bennis, K., & Bahi, L., 2016). Those technologies have their distinguished application features, advantages and disadvantages; therefore, choosing a suitable networking technology through evaluation is significant for the establishment of computer networks (Wang, L., Wang, Z., & Zou, Y., 2015).

The study on computer network reliability dates from 1955, when Mr. Lee explored telecom network. At that time, network component failures caused a sharp decline of telecom network transmission capacity, which led to call congestion, telecom network out of running, and huge economic losses. Mr. Lee considered call congestion as the link failure and proposed that network reliability tests should on the basis of connectivity.

Computer network reliability studies at early times are concentrated on communication network area (Liao, P. C., Zhang, K., Wang, T., & Wang, Y., 2016).

As Defense Advanced Research Projects Agency (DARPA) invested in “Advanced Research Projects Agency Net-work” (ARPANET) in 1968, computer network reliability studies developed greatly which caused professors’ attentions. At that time, computer network reliability studies took connectivity as a standard to measure network reliability. Network connectivity is defined as a condition that if computer network links are connected, or if computer networks which need to communicate with each other are connected, or if network nodes work well, a computer network will work regularly. Ball proved that the accurate calculation of network connectivity probability related to network processors (NP), which was widely accepted. Ball studied how network performances affect network credibility (Fedrizzi, M., & Krejčí, J., 2015).

In 1980s, with a rapid development of computer technology, the network scale and user group grew rapidly while network flow and load increased. The network manager found out that even if networks connected well, the network cannot be guaranteed to operate regularly. Network congestion and time delayed would weaken network capability so that some operations could not work regularly (Aydi, A., Abichou, T., Nasr, I. H., Louati, M., & Zairi, M., 2016). At that time, studies on network reliability turned from connectivity to network reliability (Prata, P., Fazendeiro, P., Augusto, C., Azevedo, S., & Machado, V. C., 2013).

In 1990s, as computer network developed rapidly, network reliability had gradually become a hot topic of reliability researches and studies. At the same time, computer network reliability studies were paid much attention to, as power network, electrical network, transportation network, transport network, logistic network were all related to computer network reliability assessment.

Under globalization, only productions and companies with high reliability can survive the fierce market competition. In foreign countries, researchers have related reliability studies to energy and resource conservation so as to extend materials’ usage period, apply materials efficiently, reduce working time, and make products light through reliability analysis.

Network system reliability refers to protect online resources from being illegally obtained and modified so as to ensure the completeness, effectiveness and security of network resources through certain technical skills. Therefore, it is important to establish reliable network system. According to analyzing computer networks’ construction, most networks are hierarchically organized, which can lessen the complexity of the network, and improve its practicability and compatibility (Zhai, X. Y., & Ye, H. K., 2015). Researchers can apply this feature to make layer-by-layer analysis. AHP is defined as an analytical method of multi-objective decision combining quantitative analysis with qualitative analysis, which can guide the analysis of computer network construction.

2. The Outline of Computer Network Reliability

Computer network reliability is defined as the capability that a computer network operates under certain environments and periods of time.

According to the definition, certain environment, given time and operational capability are three components of computer network reliability. Certain environment includes external environments which will cause network components' failure such as natural or war environments, as network equipments can be destroyed in war or become aging. Given time concludes the time that a failure occurs, as well as maintaining policies and time. Operation capability is measured by the performance of system functions and its reliability index.

2.1. Computer Network Systematic Efficiency

The computer network systematic efficiency is determined by network reliability and maintainability. It refers to the capability that a computer network system meets requirements of quantitative features and services, and the measurement that how a computer network can accomplish operations. The computer network systematic efficiency is a reflection of availability, credibility and inherent capability of a system. The equation is as follows:

$$E = A \times D \times C \quad (1)$$

E refers to efficiency. A refers to availability. D refers to dependability. C refers to inherent capability.

Credibility, which is decided by reliability and maintainability, refers to a workable or serviceable condition that a system is in when it is to execute tasks. Dependability means how a computer network system can accomplish operations when availability is fixed (Chen, H., 2015). It is a function relative to reliability and maintainability. Inherent capability refers to how a network can meet the requirements of its own characteristics under the condition that internal conditions are fixed. The availability and dependability of a system are functions of reliability and maintainability. The functional relationship is as follows:

$$A = \frac{MTBF}{MTBF + MTTR} = f(R, M) \quad (2)$$

MTBF refers to mean time between failures. MTTP refers to mean time to repair. R refers to reliability. M refers to maintainability. The equation shows that systematic efficiency depends on inherent capability, reliability and maintainability.

2.2. Computer Network Reliability Engineering

Computer network reliability engineering refers to an operation which applies reliability engineering methods to the whole life cycle of computer networks to study the law of computer network failures and find out resolutions so as to avoid failures, lessen harms, improve reliability of computer networks and accomplish scheduled tasks (Abdullah, L., & Qing, S. X., 2015).

In order to meet the requirements of computer network systematic capability, the law of failure and its impacts on network operations as well as maintaining strategies should be taken into consideration. When designing a computer network, one thing that should be taken into consideration is the optimization of reliability measure index (Novin, V., Givehchi, S., & Hoveidi, H., 2016). Under given fees, how to achieve an optimized design while making reliability and capability of a computer network meets needs is an important issue. If reliability and capability are fixed, how to cut down fees is also essential.

The reliability of computer network is a complicated engineering problem. The reliability engineering is a collection of engineers and management activities during study, design and operation processes in order to improve the reliability and running quality of computer networks, which can be described by the following picture (Wang, X., Li, X. R., Zhen, F., & Zhang, J., 2016):

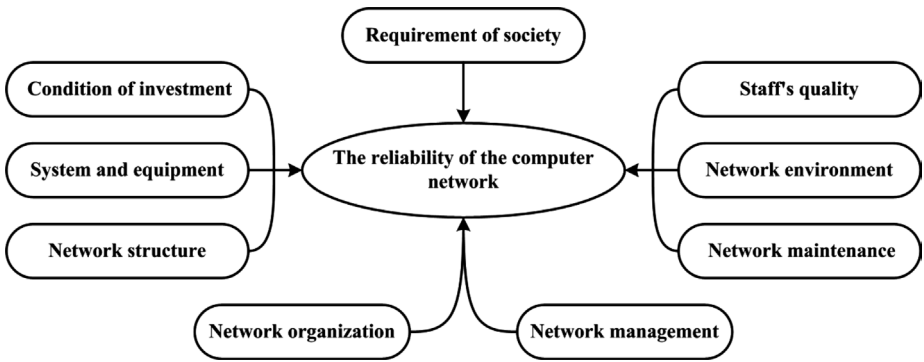


Figure 1 – Reliability Engineering of Causality

The analysis of computer network reliability engineering can be divided into three stages: design, operation, and evaluation, during which reliability involves according to systematic engineering methods.

In order to facilitate operations, the reliability researches of computer network can be divided into three levels: strategic level, tactical level and operational level, which is shown in table 1:

Grade	Research content
Strategic	Determine the objectives and tasks; Technology and management policy.
Tactical	Study the network structure and network organization, maintenance and pipeline system; Determine the evaluation index and method; Enhancing the technical levels of employees; Develop research project.
Operational	Analysis on the network operation problems, timely feedback, require; Take measures to improve the quality of network reliability and operation.

Table 1 – The Computer Network Reliability Engineering Research Content

3. The Outline of Computer Network AHP

3.1. The Fundamental Principle of AHP

AHP is an effective tool applying fuzzy mathematics theory and systematic engineering theory to deal with complicated problems which cannot be solved by quantitative methods. AHP reflects a basic method of human thinking, that is, analysis and synthesis:

First, the problem needs to be analyzed should be separated into components, which can be separated into different groups according to their relations, and form systematic hierarchical structures. Second, a pair-wise comparison judgment matrix should be established through establishing a quantitative scale and comparing components at the same level in pairs. Third, a relative weight can be calculated by judging the matrix. Finally, through calculating the synthetic weight of components at different levels relative to the systematic overall goal, issues can be solved by analyzing and using the results.

AHP provides a method to measure decision-making factors, which applies relative scale, human experience and judging ability. Under hierarchical structures, AHP follows relative scale, applies human decisions to compare the importance of relative factors at the same level in pairs and measure decisive targets following the synthetic plan from top level to bottom level. Such measure combines tangible factors with intangible factors as well as quantitative factors with non-quantitative factors. AHP is not only a basis of decision-making, but also an important measure of evaluation.

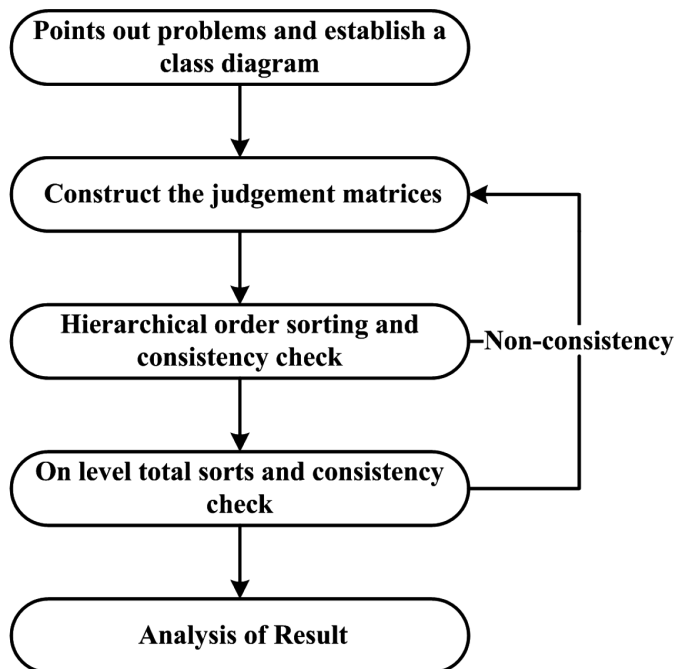


Figure 2 – The Analytic Hierarchy Process Steps

AHP is used to weight factors which cannot be weighted directly in computer network reliability evaluation. For example, in the final comprehensive evaluation, a facto weight will affect evaluation results, which cannot be decided directly, instead, it needs decision-makers to make quantificational analysis and calculate the weighted value on the basis of AHP (dos Santos, I. J. A. L., 2015).

3.2. Reliability Index of AHP

AHP reliability index can be separated into six layers: network topology, network route, network operation, network business, and network management. When assessing the reliability of computer network, those six aspects should be taken as important evaluating factors (Liu, C. H. S., & Chou, S. F., 2016).

The evaluation process is as follows:

First, schemes can be formulated, hierarchical structure model can be established and judgment matrix can be built according to those six factors. The judgment matrix is as table 2. The determine scale definition is explained in table 3.

A(k)	B1	B2	.....	B(j)	.....	B(n)
B1	b11	b12	.....	b(1j)	.....	b(1n)
B2	b21	b22	.....	b(2j)	.....	b(2n)
.....						
B(i)	b(i1)	b(i2)	.....	b(ij)	.....	b(in)
.....						
B(n)	b(n1)	b(n2)	.....	b(nj)	.....	b(nn)

Table 2 – The General Form of the Judgment Matrix

Determine the label	Definition
1	For A (k), b (I) and b (j) are equally important
3	For A (k), b (I) is slightly more important than b (j)
5	For A (k), b (I) is more important than b (j)
7	For A (k), b (I) is more important than b (j)
9	For A (k), b (I) than b (j) is absolutely important
2, 4, 5, 6, 8	The value of the two adjacent judgment

Table 3 – Determine Scale Definition Table

Second, we make single hierarchical arrangements in judgment matrix and check the consistency of results. Then, we make general hierarchical arrangements for five plans according to results of single arrangements and work out results. Finally, a consistency check is made on results. If the final number is less than 0.1, it illustrates that the general hierarchical arrangement has consistency.

4. The Reliability Analysis of AHP

The most important index measuring computer network capability is reliability, which is affected by the following factors: response time, transmission rate, data stability and connectivity.

4.1. Reliability Analysis on Physical Layer

Reliability analysis on physical layer is under certain communication equipments and media. It is an evaluating standard judging the probability of physical layer being completed at a fixed time. The detailed analysis is as follows: set F to the function of “completed physical layer”, and set communication equipments and media to $\Omega = \{G, \phi, \phi\}$. At the time, the probability is under the condition that reliability of the computer network physical layer will not be out of order at time t . The equation is as follows:

$$R(t) = \Pr\{\xi > t\} \quad (3)$$

The failure density function of computer network communication equipment can be set to $R(t)$, and the equation is as follows:

$$R(t) = \Pr\{\xi > t\} = \frac{\infty}{t \int r} (t) dt \quad (4)$$

4.2. Reliability Analysis on Data Link Layer

The data link layer reliability is measured by data traffic between adjacent nodes in a computer network, that is, a data link layer can deliver how many correct data within fixed (S) or the digit of transmittal effective data. We can set F to the function of “effective data digits that a data link layer can correctly deliver”, and set preconditions to $\Omega = \{G, \phi, \phi\}$. If bit failures are mutually independent within the data link layer, pb is used to represent the bit error rate, If is used to represent the data frame, and Id is used to represent the valid data bit. The reliability equation is as follows:

$$pf = 1 - (1 - pd)t_f \quad (5)$$

In order to ensure data transmission is correct, and there exists sequent ARQ agreement, that is, an agreement illustrates that data are repeatedly sent, in data connection layer. The equation is as follows:

$$R = \frac{\rho d(1 - Pf)}{1 + (a - 1)Pf} \quad (6)$$

4.3. Reliability Analysis on Network Layer

Reliability on network layer refers to the efficiency of nodes' connection under the possibility that the mutual independence of nodes is invalid. If $\Omega = \{G, S, T, \phi, \phi\}$, and F refers to the function that "nodes are connected under fixed time", the measure of network layer reliability is as follows:

$$R(\Omega, t, F) = \Pr \quad (7)$$

If we set $\phi(\bullet) = 1$, $\phi(\bullet) = p$, then,

$$R(\Omega, t, F) = 1 - \sum_{i=0}^n mip^i (1-p)^{m-i} \quad (8)$$

4.4. Reliability Analysis on Transport Layer

The transport layer reliability can be expressed by $R = \{\Omega, t, F\}$, among which F represents "the flow of s to $t \geq d$ ". d is a constant. $\zeta(f)$ can be set to the largest amount of data flow from the beginning point s to the ending point t . The equation is as follows:

$$R(\Omega, t, F) = \Pr\left\{\frac{f}{\zeta(f)} \geq d\right\} \quad (9)$$

4.5. Reliability Analysis on Application Layer

If we set $\Omega = \{G, S, T, c, f, \phi, \phi, U, W, \frac{1}{W}\}$, and F represents the time needed to transmit unit data. The application layer reliability can be measured by the following equation:

$$R(\Omega, t, F) = \Pr\left\{F \leq \frac{t_0}{2}\right\} \quad (10)$$

5. The Application of AHP in Network Reliability Evaluation

In the following study, we will illustrate how AHP is applied in network reliability evaluation. Five network reliability professors evaluate computer network reliability in companies A, B and C.

5.1. The Hierarchical Structure Model of the Computer Network Reliability Evaluation

Considering factors such as management and technology, the hierarchical structure model of the computer network reliability evaluation is as follows:

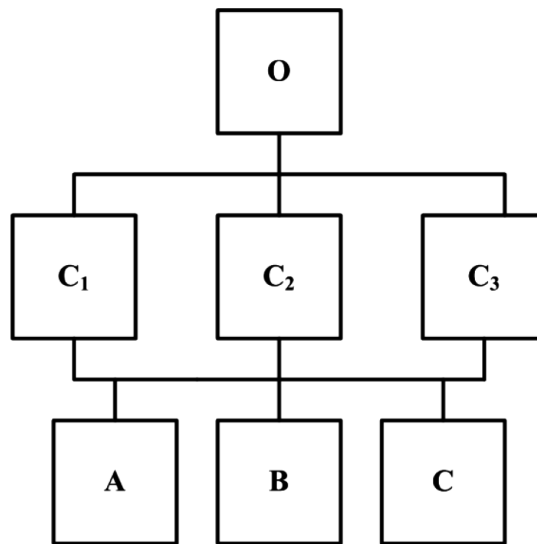


Figure 3 – The Hierarchical Structure Model of the Computer Network Reliability Evaluation

In fig3, layers include target layer (O), criterion layer (C_1 -the reliability in management, C_2 -the reliability in physics, C_3 -the reliability in logic), scheme layer (A, B, C), sub-criterion layer and other layers which will not be listed here.

5.2. Analysis of Judgment Matrix Structure and Calculating Result

During the evaluation, professors compare relative importance of factors in the hierarchical structure model of the computer network reliability evaluation. According to their decisions, we establish judgment matrixes at different levels as follows:

O	C1	C2	C3	Weight Value
C1	1	0.68	0.27	$W_1=0.169$
C2	1.47	1	0.61	$W_2=0.288$
C3	3.72	1.83	1	$W_3=0.543$

$$\lambda_{\max} = 3.022 \quad CI=0.011 \quad RI=0.58 \quad CR=0.019$$

Table 3 – Relative to the target layer rule layer of judgment matrix

We work out weight vectors of those matrixes applying the root method of single hierarchical arrangements and results are shown in table 3. In table 3, we also list the largest eigenvalue of the judging matrix and the result of the consistency check. It can be seen from the result that each judging matrix meets consistency.

If we bring weighted values W_1, W_2, W_3 into $W_l = \sum_{i,j} w_i w_{ij} w_{jl}$, we can calculate the

weighted value of network reliability comprehensive assessment of units A, B and C. In table 7, we list the weighted value of one layer's factors to its upper layer's factors and general weighted value of evaluation objects of each layer to the general target "the evaluation of computer network reliability".

The weight of the criteria layer relative to the target layer		The weight of the project layer relative to the target layer		
C_1	0.169	A	B	C
C_2	0.288	0.316	0.347	0.337
C_3	0.543			

Table 4 – Each Layer Weights Calculation Results

Table 4 illustrates that the weighted value of unites A, B and C are separately 0.316, 0.347 and 0.337. Such result shows that the general condition of computer network reliability of unit B is the best as computer network reliability levels are close of three units.

6. Conclusion

The computer network reliability is an important index to measure computer performance. As social life depends more on computer networks, computer technology has developed rapidly and been applied widely, and the production efficiency has improved at a large scale which has greatly improved people's living standards. AHP can be applied to lessen failures and maintain network's normal operations with efficient and organized analysis. This essay explains AHP, which can improve computer network reliability through multi-directionally analyzing computer network reliability with the combination of AHP application mode and influential factors.

In conclusion, most networks are hierarchically organized at current, which can reduce the complexity of the whole network and improve its practicability and compatibility. Therefore, we can make layer-by-layer analysis towards network reliability and network failure according to this feature. Moreover, AHP is a multi-objective decision analytical method combining quantitative analysis and qualitative analysis, which can guide the establishment of computer networks.

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Computer Assisted Instruction to Improve the Tennis Forehand Strokes Test Research

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Abstract: In recent years, the teaching system of sports training released great changes, teachers use computer aided teaching of tennis hitting the front of training, this paper combined with the support of computer technology, to explore a new method of teaching, improve students' practical technical level, to improve the teaching quality of tennis. Summing up years of tennis forehand stroke technique on the basis of the teaching, this paper analyzes the computer aided teaching in tennis forehand pumping batting training needs analysis and design principle, research the implementation of the computer aided teaching, using control variable method of experimental group and control group comparison group, through the traditional teaching method and the computer aided teaching method teaching experiment results analysis that computer assisted instruction in tennis teaching has more feasibility and significance.

Keywords: CAI; tennis forehand stroke; teaching quality.

1. Introduction

Since entering the 21st century, people's quality of life get a substantial increase, sports has become the life, physical education and lifelong physical education further engagement, sport has been Fu enhance physique service mission formation. The arrival of the new century, we will face is the challenge of the information age, along with the more and more extensive application of computer assisted instruction, its role in high colleges and universities public sports theory teaching is particularly prominent. With the rapid development of multimedia technology, network technology and application of computer aided teaching education has become the important content of modern education reform (CONSOLO D A., FURTOSO V B., 2015). Due to the network is the expansion of a variety of media integrated teaching information, interactive teaching process, students' position of the center, the diversification of teaching methods, teaching situation of virtual functions, its use expanded teaching content, open teaching environment, the computer aided teaching development and application of science is gradually from the edge of the high colleges and universities public sports theory teaching reform to the center. Exploration of college public physical education theory, the computer aided teaching means and methods, extend the teaching process, has become a high teacher sports educators to explore a hot topic (CONSOLO D A., FURTOSO V B., 2015).

In the 1980s, the multimedia aided teaching began to appear, in the classroom teachers use a variety of electronic media such as, slide projector, audio, video and other technology used in teaching. Therefore, we are now commonly referred to multimedia teaching is refers to the use of multimedia computers and with the pre made multimedia teaching software to carry out the process of teaching and learning activities. It can also be called Computer Assisted Instruction (assisted instruction computer, that is, CAI) (Buendgens-Kosten J., 2016).

Ma Xiaolan's "multimedia technology in teaching of Taijiquan application and evaluation", Li Lichang's "the multimedia teaching courseware in sports teaching application" and Ruan Huaiyun in "the multimedia computer assisted instruction (MMCAI) application of auxiliary teaching means multimedia computer and other modern photography system in conventional sports teaching in the research and pointed out that" swimming teaching reform, can show the correct technical illustrations and vivid explanation and demonstration, to stimulate students' learning interest and enthusiasm, can quickly and accurately establish and form action representation, emphasize the individual initiative and active learning, improve the efficiency of teachers, improve teaching quality, optimize teaching (Seiz Ortiz R., 2015). Heng Xin Yang in the "level teaching" mode of: (Cadavid, J. M., & Gómez, L. F. M., 2015) to swimming class for example "in put forward:" stratified teaching "thought, originated from Confucius put forward" teaching students in accordance with their aptitude ". "Hierarchical teaching" in class teaching is an important means of system according to the actual learning level of students. Original Soviet Union educationist Bruno in "education and development" is also presented including backward students, all the students are getting the general development "principle (Yunus M M., Salehi H., Amini M., 2015). "Layered education" is to respect students' personality, promote the development of students, including students of all the effective measures. American psychologist bloom in the "master learning theory" pointed out: "many of the students in the study failed to achieve excellent results, the main problem is not the wisdom of the students lack the abilities, but in the absence of proper teaching conditions and reasonable helped create the", "if appropriate learning conditions, most of the students in learning ability, learning speed, further learning motivation, and many will become very similar." Here said the conditions for learning, refers to the students to learn and achieve mastery of the necessary learning time and learning environment, give individual guidance and new learning opportunities etc.. "Level teaching" is to maximize for different levels of students with the "learning condition" and "necessary new learning opportunities," (Khoshnoud K., Karbalaei A R., 2015).

Computer aided teaching is refers to in the teaching process, according to the characteristics of the teaching target and the teaching object, through the teaching design, reasonable selection and use of modern teaching media, and the organic combination of traditional teaching method in the teaching process, to the role of multimedia information to students, the formation of a rational structure of the teaching process, to achieve the best teaching effect (Patil V V., Rao P., 2016). Computer assisted instruction to its unique function and have the interesting features, which for the students to focus attention, stimulate students' learning motivation has a great value. It provides many possibilities is often our common teaching methods are difficult to match. Multimedia teaching the teaching contents of silent become vivid, static and dynamic, to bring students into, stealing quick teaching, to enable students to feel great interest in sports, naturally into the state of positive thinking in (Rochmahwati P., Pamungkas Z B., 2015).

The use of CAI on tennis forehand stroke pump research and training, on the one hand, part of substitute teachers by means of language to achieve the teaching function, (Cadavid, J. M., & Gómez, L. F. M., 2015) teachers more steering to organize teaching activities, improve the efficiency of classroom teaching; on the other hand, students can according to their own situation, through simple computer program operation, choose the content they need to learn, which is conducive to the cultivation of students' self-learning ability and to cultivate students' practical ability. The multimedia CAI introduced to tennis technology teaching, modern teaching method and the teaching of tennis fusion, optimization of tennis forehand strokes hit rate and improve the tennis player's technical level (Lai S K., Chen C T., Chou Y M., 2015; Cardoso D C B., Louzada G A S., 2015).

2. Computer Assisted Instruction Analysis and Design

Computer assisted instruction (Computer Assisted Insertion) referred to as CAI, is an important field of computer application in education. American IBM company in 1958 to develop a successful world's first CAI teaching system, from the late 70s of the 20th century began, I state the research and application of CAI. With the development of computer technology development and computer aided teaching activity, at present, in the teaching, the computer can not only partially substitute teachers and students interaction in individual, also support teachers collective teaching, but also through the network carry out distance teaching and learning activities, greatly expand the connotation of CAI and the activities and functions. Computer assisted instruction (CAI), is the application of modern educational technology learn to change the traditional teaching methods, provide a variety of active teaching mode, create a vivid teaching environment, and beyond the general audio-visual category, some were not easy or difficult to form the phenomenon and its dynamic process show in front of learners, learners increased from perceptual knowledge to rational knowledge, convenient teachers on the key and difficult to explain, so as to improve the teaching quality and teaching efficiency. Teachers and students use computer for information storage, processing and presentation function to support the teaching and learning of an activity (Khan S A., Ali M., Hussain H F., et al., 2015).

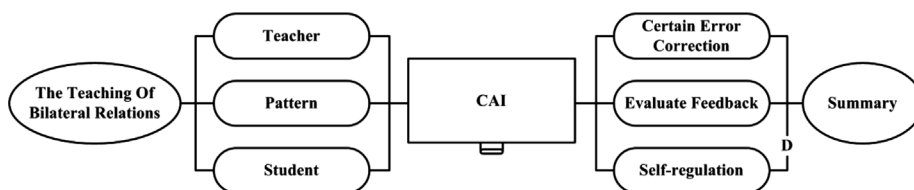


Figure 1 – CAI Framework Design

2.1. Demand Analysis

Computer aided teaching can give full play to the students subject role and teachers' guidance, ensure asynchronous of individual teachers and guidance for students' learning, is an effective way to cultivate students self-learning ability and creative ability, reduce the burden of the teachers and students of teaching, in the short term to obtain better teaching effect, can eliminate the teaching situation of the low efficiency of the

sports teaching which exist for a long time, to promote students' all-round development. To cultivate students' self-study ability and the ability to create placed in the first position in the school teaching, at the same time, the lifelong learning time and space to the educated, the mastery of skills into practice, which reflects the objective law of the concept of modern teaching trends and physical education and the cultivation of the students' self-study ability and develop the students' creative talents is improve the fundamental guarantee of the quality of teaching (Schifter L., Pastrana P A., 2015).

Tennis training is provided to specially selected students in tennis teaching aided teaching, teachers can use multimedia courseware in the classroom for teaching demonstration and explanation, students can study by themselves through the courseware. In the questionnaire survey of students at the same time to understand, in class most of the students are in contact with multimedia teaching the teaching methods. The main forms is to watch the slide and instructional DVD (Yoo S K., Bang J H., Chung Y., 2015). The students watch after feeling more vivid, like in sports teaching which try to use the multimedia CAI teaching. From the strict sense that slides and instructional DVD is a kind of multimedia, because there is no ability to interact and so is not truly multimedia courseware. CAI courseware is a kind of computer program, or a kind of computer software. This software can achieve a certain teaching objectives. For teachers, it can help the teaching for students, it can help to learn, preview or self-study materials (Michalski R., 2015).

Cause the student to pay attention in class, do not intend to pay attention to source to external stimuli, people to this kind of stimuli with direct interest, therefore, do not intend to pay attention to maintenance can be lasting, less energy consumption, audio-visual teaching with novel and interesting and between two different pictures exist between, between the stimuli are strong gap, so it causes the sustain the movement of the students pay attention to. In terms of memory, through the explanation, watch can make the memory effect to maintain a longer time (Rahman M., Darus S., Hussain N., 2015).

2.2. Design Principles

In humanistic education, people attach importance to student subjectivity advocated the development of personality and pursues the self value realization. Multimedia computer assisted instruction is to learners as the center, according to different learners develop different learning objectives, teaching plan, teaching means, the foundation is close to the level of students have common goal, overcome the teaching process in the discrete factors and negative effects, to create an optimized teaching environment. In the optimization of the teaching environment, give full play to the students as the main role in the process of students, the self realization of the choice of leaving the learner, stimulate students' learning motivation and desire of new content, stimulate students in learning and practicing the creative and self-learning ability (Kumar A M V., Chinnakali P., Shewade H., et al., 2015).

In terms of teaching theory, the computer aided teaching can give full play to the students subject role and teachers' guidance, ensure asynchronous of individual teachers and guidance for students' learning, is an effective way to cultivate students self-learning ability and creative ability, reduce the burden of the teachers and students of teaching, in the short term to obtain better teaching effect, can eliminate the teaching situation of

the low efficiency of the sports teaching which exist for a long time, promote student's all-round development. To cultivate students' self-study ability and the ability to create placed in the first position in the school teaching, at the same time, the lifelong learning time and space to the educated, the mastery of skills into practice, which reflects the objective law of the concept of modern teaching trends and physical education. Developing students' self learning ability and developing students' creativity is the basic guarantee of improving teaching quality.

2.3. Tennis Forehand Strokes Essentials Analysis

Action elements include seven aspects: body posture, movement, movement time, movement speed, movement speed, the strength of action and action rhythm. Now from the action of the various elements respectively on the forehand heavy and difficult technical movement analysis, aims to help group for beginners to clear the concept of action, promoting mastery of the technique.



Figure 2 – Tennis Behavioral Essentials

Body posture. In the forehand technology is mainly manifested in the ready position, the ball to ball and the position and the swing sideways to intercept the ball. Ready posture is mainly manifested in two aspects: one is concentrated attention to judge and predict to the position of the ball, easy to move; the second is to keep the body balance and easy to hit. Identify the reasonable point of the ball is mainly reflected in the ball to deal with the relationship between the ball and the people.

Motion trace. In the forehand technology mainly in the backswing and swing of the route and direction. In the back of the racket when, to take arms to clamping in the armpit, with the body of rotation and natural, short back backswing, take the route is backward in line. The right shots must "meet up", namely early swing, along the trajectory of the ball swing out, shoot with the ball in his in front of the body touching, pat is in motion along a straight line with the ball collision, it with the trajectory of the ball almost in a straight line.

Movement time. A complete ball movement including to predict the ball, move, swing, after hitting the reverse. **Movement speed.** Is opposite in the forehand in the process to the direction of the direction of the ball and swing, two opposite movement, if the ball to fly ball point began to swing, racket and ball to the actual contact point will behind the best ball point, resulting in difficulty in force, therefore, is to grasp the reasonable time of ball, slightly ahead of in the hitting point essential racket. **Rate of action.** Forehand process is mainly manifested in the movement and hitting action. Mobile is mainly reflected in from to judge the ball to start, quick start, with the forehand hitting moving steps to a reasonable position, and then to the ball after the snap back.

Action force. In a coordinated force in the forehand is mainly reflected in a shoulder hip rotation power technology and various joint chain. Beginners should first clear the ball strength mainly from tic hip rotation shoulder turn, driven by the size of the arm to wave direction fast ball, rather than by closed arm and wrist. Hold the shot of the wrist in the racket, swing the ball in the process, only batting moment is force, tension, other time should in a relaxed state, holding the racket like holding a bird.



Figure 3 – Tennis Forehand Behavioral Essentials

3. Results Analysis

3.1. Analysis of the Assessment Results of Tennis Forehand Stroke

In the course of tennis teaching technology assessment methods are shown below:

1. in the midfield net at the tee, hit the ball with a forehand test.
2. at least 3 of the 2 test personnel to test the ball technical water quality score.
3. there is only one test officer for each test.
4. test according to the order of the list.

In the experimental group and the control group of students from the forehand swing technology assessment results analysis as follows:

Technical evaluation by the department assigned 3 to 5 examiners teachers score, respectively. Prior to assessed according to the standard, unified scoring scale, try to make it fair and accurate scoring.

Technical evaluation score	Forehand hit			
	Experimental group		Control group	
	Number	Percentage(%)	Number	Percentage(%)
8.9–10	14	23	10	17
7.6–8.5	36	60	24	40
6–7.5	10	17	16	13
<6	0	0	0	0
<i>in all</i>	60		60	

Table 1 – Experimental Group and Control Group Forehand Technology Assessment Results

From the table, the results can be seen: experimental group and control group students in forehand drive are differences. In the experimental group students and the control group students have significant difference (in the highest grades is 8.6 10 points in the experimental group students and controls the number of students differ 4; in 7.6 a 8.5 segmentation the difference between the two groups of the number of students of 12 people; in the low stage, the number of the students in the experimental group significantly lower than that of the control group. From the above results are described in the technical evaluation of the index on the use of computer assisted instruction in the experimental group, the teaching effect was significantly higher than in the traditional teaching of the control group.

3.2. Analysis of The Results of the Experimental Group and the Control Group

In the teaching process, teachers timely record (two hours) students in each class exercises, and of every student lesson learned and reached number requires teachers to statistics. Hours of sub standard statistical analysis of the table by the number of hours of statistical analysis of the number of tables for the analysis of the following:

	Period									
	4 h	5 h	6 h	7 h	8 h	9 h	10 h	11 h	12 h	13 h
<i>Hours apart</i>	2	5	9	21	28	34	47	51	57	60
	1	4	7	12	18	27	34	42	49	54
	1	1	2	9	10	7	13	9	8	6

Table 2 – The Experimental Group and Control Group Class Comparison Results Analysis

Through 10 segmented time teaching comparison experiment, record the number of each time segment of two groups of students in time. It is found that the two groups of students to learn tennis forehand stroke technique exist significant differences. The experimental group students learn tennis forehand stroke technology progress significantly faster than that of the control group (see chart), using the statistical graph can significantly reflect. The results can be considered that the difference between the two groups is mainly due

to the different teaching. Show in the computer aided teaching mode can more arouse student's study enthusiasm, stimulate the students' learning motivation, cultivating student sports skill learning and exercise persistence and avoid the emergence of sports teaching in various psychological exhaustion model of premature, can better cultivate students' long-term participation in physical exercise consciousness.

3.3. Results of Comprehensive Performance of the Experimental Group and the Control Group

After the experimental teaching, for all students usually results, theoretical achievement, technical achievements and the scores of skills statistics, according to the Institute of comprehensive scoring (total score = usually score x 10% of theoretical results x + (technical achievement x 50% + skill scores x 50 x 50%).

	Average grade ($\bar{X}_1$)	Theoretical score($\bar{X}_2$)	Technical achievement ($\bar{X}_3$)	Overall score ($\bar{X}$)	P
<i>Experimental group</i>	85	81	84	86.95	P<0.05
<i>Control group</i>	82	74	78	80.35	
<i>Discrepancy</i>	3	7	6	6.6	

Table 3 – The Experimental Group and the Control Group Students Comprehensive Comparison

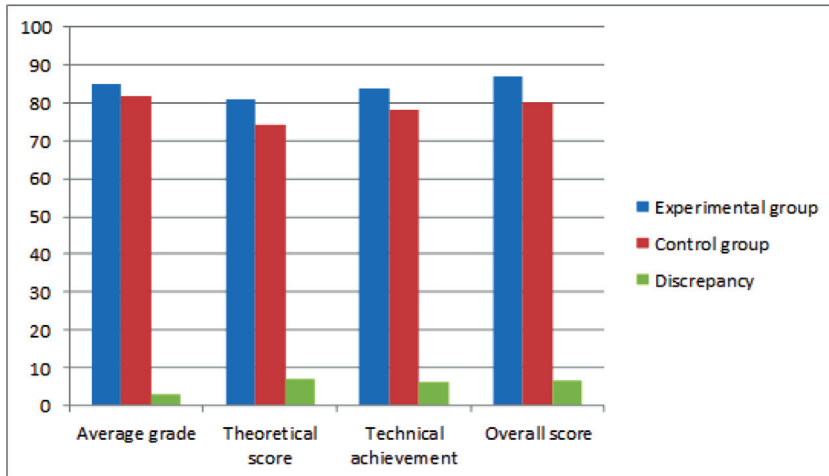


Figure 4 – The Experimental Group and Contrast Group Comprehensive Score Histogram Contrast

In the tennis forehand stroke comprehensive performance analysis table that experimental group of students from each of the segments were better than students in the control group. This shows that in tennis multimedia computer aided teaching process, students willing to learn, and to improve the students' learning interest and motivation for the

students in the experimental group to improve the forehand accurate description of the understanding of the action in the process of tennis teaching, the experimental group students more thoroughly, more accurate representation of the action.

4. Conclusion

Computer assisted instruction learned advanced teaching theory, reference to the achievements of teaching and scientific research, and follow the students in practice in physiological and psychological characteristics. The teacher can use Computer Assisted Instruction to cultivate students' self-consciousness, and promote the development of students' self. Through the computer aided teaching and training for tennis players, the physiology and psychology of the students get a better training and technical level has improved significantly.

Through the experimental group and the control group the experimental results show that through the use of computer aided teaching in the experimental group students and the control group students in technical movements, there was significant difference in the experimental group and control group in the forehand ability are basically consistent with the case. The students of the experimental group and the control group were significantly different in the number of false action. Results show that in tennis multimedia computer assisted instruction, student interest in learning and concentration, tennis technical standards have markedly improved, the experimental group students to action understanding more thoroughly and more accurate representation of the action. Computer Assisted Instruction to improve the technical level of tennis has a certain guiding role.

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Research on Computer Precise-Optimization Algorithm of Predictive Data Based on Electric Load Measurement

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Abstract: Objective: In order to make more accurate prediction of electric load measurement. Methods: Establishing the computer precise-optimization algorithm of predictive data based on electric load measurement. Process: This paper introduces the development status of the electric power industry system, analyzes the problem of power system's load forecasting, construct the computer optimization platform, and establishes the mathematical model of fuzzy time series prediction algorithm. Results & Analysis: This paper studies the classical prediction techniques in modern forecasting, analyzes the experimental data of the prediction model, and finds that the prediction technology combining computer optimization algorithm has more accurate prediction of electric load. Conclusion: The forecasting optimization algorithm of power load based on computer technology in this paper is a highly efficient prediction method.

Keywords: Precise-Optimization algorithm; load forecasting; computer optimization platform; power system.

1. Introduction

With the continuous development of science and technology and social economy, China's electric power industry system also has great development. Power system in our country and the continuous development of the power grid management increasingly modernization and complicated, making power system load forecasting problem more and more arched people attention, and has become a modern power system science an important research field. Due to the electric energy production, transmission, distribution and supply consumption is almost at the same time to complete, so as a special kind of energy, electric energy to a lot, which makes the power system generation should keep consistent with the change of system load, in order to achieve the dynamic consistency meet the balance of supply and demand (Filimonova, A. A., Kazarinov, L. S., & Barbasova, T. A., 2015). Otherwise light will influence the quality of electric power supply

and demand, cause unnecessary waste of energy; heavy endanger the safety and stability of the whole power system. So as to ensure the security and stability of power system, economic operation, must be to master various load changes and future development trends, which makes power system load prediction has become an important research topic in power system. Figure 1 optimization Center for power system load forecasting (Abreu, A., Rocha, Á., Cota, M. P., & Carvalho, J. V., 2015).



Figure 1 – Optimization Center of Power System Load Forecasting

Prediction is the premise and foundation of decision and control. Power system load forecasting result is accurate or not, have a very important influence on the operation of power system in our country's safety, stability, economy (McGranaghan, M., Houseman, D., Schmitt, L., Cleveland, F., & Lambert, E., 2016). Accurate power load forecasting normal rational arrangement of operation of the internal power generating units, to maintain security and stability of power grid operation, reasonable arrangement of unit maintenance scheduling, ensure social production and people's normal life; can decide newly installed capacity and the size of the grid scheduling control, reduce the cost of power generation, increase the economic benefit and social benefit. Power system load forecasting is an important part of energy management system and distribution management system is precondition of the realization of automatic generation control and economic dispatch control and is the basis of power system planning and scheduling. It relates to the power system planning and design, operation of the power system economic, safety, reliability and stability of the, is an important research field in the operation and management of modern power system (Nadtoka, I. I., & Balasim, M. A. Z., 2015).

2. Data and Methods

2.1. Power System Load Forecasting Analysis

Power system is a dynamic and complex energy conversion systems, it from the mutual effect of the three parts of the interaction: generation, transmission and distribution. (Cadavid, J. M., & Gómez, L. F. M., 2015) Power plant is a producer of electric energy and the electric energy by high-voltage transmission network and low voltage distribution network is transmitted to all users, and by the users of the electrical equipment consumption. The load of electric power system refers to the general name of the power system, which is usually referred to as the load. Power system load is constantly changing, and this change

showing a certain continuity, periodicity and nonlinear characteristics. At the same time, but also contain some randomness (Liu, Y., Xie, H., Wang, L., & Tan, K., 2016). It is affected not only by the influence of internal factors, but also influenced by the external a variety of complex and uncertain factors, which makes the power system load forecasting not only according to the inherent regularity of load changes, but also taking into account the various random influence factors affect the change of the load (Alrashidi M R., El-Hawary M E., 2006). The load of power system affected by many factors, such as external climatic factors (temperature, humidity, precipitation, wind speed, sunshine, etc.) and personal behavior factors such as holidays, personal preference, economic environment and various unavoidable random disturbance factors and sudden events. But in actual power system load forecasting process, unavoidably, we could not consider all factors, on the one hand because of the difficulty in collection and observation data of all the factors, on the other hand is too many factors will not only lead to the difficulty in modeling, and the consequent may bring complex algorithm and model is not steady, and many other problems. So in consideration of the factors of the impact of power system load forecasting, to seize the several key factors analysis can be. These key factors can be summarized into four types: self factors, time factors, climatic factors and random factors. Its factors: the change of power load is a continuous process, in the load curve showed a continuous smooth waveform, the trend has a certain continuity and delayed (Yao A W L., Ku C H., 2003). Factors such as work day type, holidays to load variation mode influence larger; climatic factors: mainly refers to the temperature, humidity, rainfall, wind, sunshine external climatic factors, especially temperature had the greatest influence on the load; random disturbance factors: other can lead to changes in the load model factors, it is unavoidable (Elsheikh, R. F. A., 2015). To the advantages and disadvantages of better evaluation and prediction model or forecasting method, gives the following a few commonly used evaluation forecast model or method to predict the excellent standard. Remember: R_t is the actual value of t time load; P_t is time load forecast value; N is sample number.

Mean absolute error:

$$MAE(\cdot) = \frac{1}{N} \sum_{t=1}^N |R_t - P_t| \quad (1)$$

Mean absolute percentage error:

$$MAPE(\cdot) = \frac{100}{N} \sum_{t=1}^N \left| \frac{R_t - P_t}{R_t} \right| \quad (2)$$

Root mean square error:

$$RMSE = \sqrt{\frac{1}{N} \sum_{t=1}^N (R_t - P_t)^2} \quad (3)$$

Maximum absolute percentage error:

$$MAP = \max_{i=1,2,\dots,N} \left(100 \times \frac{|R_t - P_t|}{R_t} \right) \quad (4)$$

Relative percent error:

$$RPE = \frac{R_t - P_t}{R_t} \times 100\% \quad (5)$$

Absolute percent error:

$$APE = \frac{|R_t - P_t|}{R_t} \times 100\% \quad (6)$$

2.2. Computer Optimization Platform

Computer integrated manufacturing system (CIMS) is in the 1970s began to rise in the manufacturing of high technology, it will create technology development process in the maturation of various decentralized system combined into an organic whole. In the past twenty years, CIMS in manufacturing industry and continuous process industry has been greatly developed and is generally considered to be the future of the industrial control model. CIMS in continuous process industry realize that computer integrated process system (CIPS), the popular trend is the overall design, the distributed implementation of the strategy, the key is to solve the integration of existing systems integration and local system. An enterprise's CIPS hierarchy is shown in Figure 2. In Figure 3, the bottom layer and specific binding most closely, with the wide application of DCS, industrial control computer, for the realization of CIPS laid the solid hardware foundation (Logenthiran T., Srinivasan D., Khambadkone A M., 2011). In the direct digital control layer, has the considerable control software package and a variety of graphical configuration tool, the structure of the system is very convenient; and to monitor the layer optimization has become the bottleneck in the implementation of CIPS. The main problem is the lack of a software support environment, large investment, strong specificity, portability and high maintenance costs. Therefore the development of suitable for monitoring and optimizing layer integration needs the software platform, has become the key to realize the integration of the layer system. It is the only way of software integration, system is also from the hard integration, closed integration to soft integration and open integration of key technologies (Lamedica R., Prudenzi A., Sforza M., et al., 1996).

2.3. Classic Prediction Technology

Modern prediction techniques mainly include the method of artificial neural network, fuzzy prediction method and grey prediction method, expert system prediction method, wavelet analysis method and data mining technology.

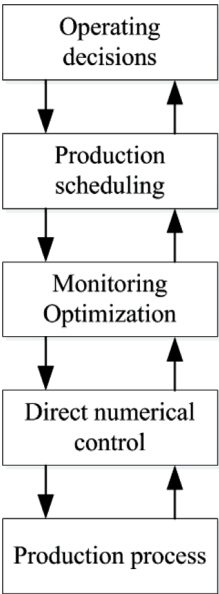


Figure 2 – CIPS Hierarchy

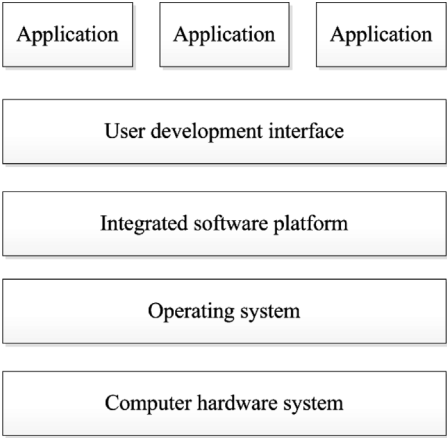


Figure 3 – Structure of Integrated Software Platform

Artificial neural network method: Power load forecasting based on neural network technology, the utility model has the advantages of is simulating human intelligent processing of a large number of non structural and non precise regularity with adaptive function, has the information memory, the characteristics of autonomous learning, knowledge reasoning and optimization calculation, especially the self learning and adaptive function is not available in the conventional algorithm and expert algorithm

technology. Therefore, prediction is one of the most promising application areas of artificial neural network, and has a very broad future. Due to the suitability for artificial neural network to solve the problem of time series prediction, especially in the prediction of stationary random process. In the power system load forecasting for application in theory is feasible. Now the most is using the error back propagation algorithm (error back propagation, also known as BP) for short-term load forecasting, the commonly used is a simple three layer model, can realize from the input to the output of the non linear mapping any complex functions, the main idea is the historical data of power load effect of some factors as input, such as the day's weather temperature, weather, wind, peak and valley load and load, these factors as input of artificial neural network, through the input layer, hidden layer and output layer neurons function to generate the final output, and output with the desired transmission. If not, revise each weight until reach the precision requirement is, is to determine the weights to forecast work, as long as the to be measured on the corresponding stimulus input neural network can be related to the output, namely pre test results. The artificial neural network has the function of associative and reasoning, so for the training process, there have been no, neural network can also forecast (Benaouda D., Murtagh F., Starck J L., et al., 2006).

Fuzzy forecast method: Fuzzy prediction method with fuzzy theory and method to the relationship between the comprehensive analysis of power load and various factors, many uncertain information to determine, the fuzzy matrix to describe the demand of power load, using fuzzy set theory of principle solution for load variation can be said contact between which it said something closer to the actual, use it to solve the problem of load forecasting is a very meaningful exploration. The utility model has the advantages that the forecasting results can be provided with intervals and probability forms, and the accuracy is high. The disadvantage is that it is required to provide more historical data, which is difficult to use. This method is especially suitable for the future development of a new economic development zone, the uncertainty in long-term load forecasting. At present, fuzzy prediction method are mainly fuzzy linear regression method, the recognition method of fuzzy clustering, fuzzy exponential smoothing method, fuzzy similarity priority ratio method and the maximum similarity method.

Grey forecasting method: Grey system theory all random variation as the grey weight change in a certain range, commonly used accumulated generating operation (AGO-Accumulated generating operation) and IAGO (IAGO-Inverse Accumulated generating operation, untidy original data is arranged in the form of rules of the formation of a strong data column. Using differential equation of grey model (GM-Grey model) as a prediction of power system the single index (such as load), to solve the differential equation of the time response function is the solution of grey forecasting model, the accuracy and credibility of the model calibration and correction, on the basis of the model to predict the future load. This method is suitable for short, medium and long period of load forecasting.

Expert system prediction method: Expert system is the artificial intelligence of a important research field, it is a computer program system with a large number of professional knowledge and experience to solve a special and difficult problem to the level of a human expert. The expert system can acquire knowledge from human experts there, to express in a certain way, and storage, management and maintenance. Through the comprehensive application of knowledge and experience of experts and the judgment

and reasoning and expert system was able to solve complicated problems in the real world. Therefore, the expert system is the knowledge information processing system. With the rise of the application of the fuzzy theory, the fuzzy expert system is usually used in the system (Zong Y., Kullmann D., Thavlov A., et al., 2012).

Fuzzy sets and fuzzy logic to represent and deal with the uncertainty of knowledge of the expert system are called fuzzy expert system. Fuzzy expert system is known as the second generation expert system. On the structure and design method of expert system, expert system and fuzzy expert system are similar to conventional. The fuzzy expert system mainly needs to solve two problems, which are fuzzy knowledge representation and fuzzy reasoning method.

At present, there is no major general application of expert system in practice. Including the application of expert system in the daily load forecasting and prediction process to establish a prediction model for preliminary forecasts of daily load to be measured, combined with expert system for preliminary prediction results are corrected. Also includes to modify the preliminary results of load forecasting using fuzzy expert system, and the application of expert system in the medium and long term load forecasting of each prediction model of evaluation and decision making.

Expert system technology is applied to load forecasting can overcome single algorithm of one sidedness and program of the whole process, the method has the advantages of quick decision. This method although there are broad prospects, but due to the lack of experts predict, forecast the process prone to human error, in the construction of database and expert experience mathematical rules exist a series of difficulties. At present, there is not much application in practice (Makarov Y V., Loutan C., Ma J., et al., 2009).

Wavelet analysis method: Wavelet analysis has good localization property both in time domain and frequency domain, the load of power system there are the characteristics of multiple periodic, is refers to the load curve as multiple frequency interleaving together mixed signal, the application of wavelet analysis to focus on any details, the dyadic wavelet transform through the power system hourly load sequence, projection on the different scales, of each scale are predicted after reconstruction, complete forecasting results are obtained. At present, mainly used in short-term load forecasting.

Data mining technology: The so-called data mining is from the vast amounts of data to extract implicit in which previously unknown, but it is potentially useful information and knowledge and express them as a senior process of mode can be understood. Data mining, which was produced in the late eighty's, is a hot research topic in the world. It is the database knowledge discovery (discovery in database knowledge, abbreviated as KDD) of the core technology. Salient features of the data mining is its strong data processing ability, can discover useful laws, rules and relationships, patterns, such as knowledge from large amounts of data (Hao, C. H. E. N., 2007). Including clustering analysis, classification analysis, time series similarity analysis, correlation analysis, regression analysis etc.

2.5. Fuzzy Time Series Prediction Algorithm

According to the change range of historical time series data, the definition of the domain interval:

$$U = [D_{\min} - D_1, D_{\max} + D_2] \rightarrow [L, R] \quad (7)$$

Here: D_1 and D_2 is two suitable positive, $D_{\max}$ and $D_{\min}$ were minimum value and maximum value in the time series data; for inter cell $u_1, u_2, \dots, u_t$, there is $\sum_{i=1}^t u_i = U$, where,

$$u_i = [L + (i-1)l, L + il] \quad i = 1, 2, \dots, t \quad (8)$$

L for the interval length, $t = (R - L) / l$, remember the plot between the midpoint of the u_i is m_i ; Fuzzy set and fuzzy historical data:

The fuzzy set is defined as follows in the above mentioned domain:

$$A_i = f_{A_i}(u_1) / u_1 + f_{A_i}(u_2) / u_2 + \dots + f_{A_i}(u_t) / u_t \quad (9)$$

That fuzzy relations: take a certain algorithm and to prove the fuzzy relationship between t moment and $t+1$ constantly; on the assumption that the training phase moments and the moments of the fuzzy relation, denoted by: $A_t \rightarrow A_{t+1}$; prediction stage t moments and the moments of the $t+1$, fuzzy relation denoted as. Calculated predictive value: this part is divided into two stages: training phase and forecast period. First part of the data using certain rules of the algorithm training, get its regularity, and then prediction algorithm for the future development trend is predicted. The prediction, reuse rules to fuzzy, in order to get the accurate prediction data. Fuzzy time series forecasting the basic flow chart is shown in Figure 4:

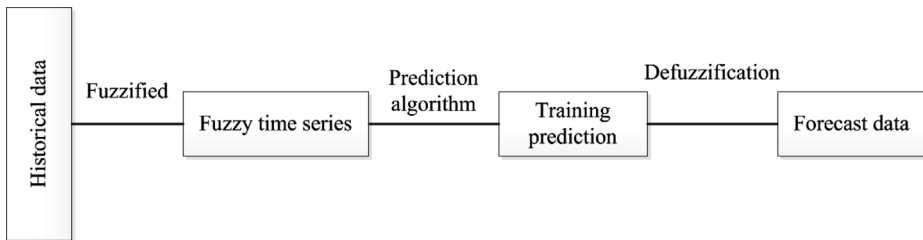


Figure 4 – Basic Flow Chart of Fuzzy Time Series Prediction

Fuzzy time series forecasting algorithm mainly includes the determination interval length of the segmentation algorithm, basic rules and algorithm of fuzzy, training, forecasting stage window selection algorithm and the prediction algorithm and so on. Different scholars from different angles, improved and optimized to improve the prediction algorithm. Mainly divided into three categories: the interval length of the proof of higher order selection; fuzzy relation; multiple factors analysis (Uslar M., Schmedes T., Lucks A., et al., 2005).

3. Data and Analysis

By trial calculation, the average daily load forecasting accuracy can satisfy the user's requirement, and the maximum relative error is less than. Attached below provincial power network load forecast report on Wednesday May 13, 2010. The same forecasting model can predict the accuracy of the results. The key point lies in the data preprocessing. In the model of the trial stage not weekends, holidays, climate temperature blast these data as the abnormal data to be removed, but to identify the difference grey prediction model for all unknown parameters, on the basis of the model to predict daily load, prediction accuracy of most meet the users of greater than 95% of the requirements. If the sequence of data contains the date of weekends, holidays, climate and temperature changes and other data, then the difference between the grey model to predict the day's load forecast accuracy will not necessarily meet the user requirements. It can be seen that the method of data preprocessing is equally important to predict the process of a certain change (Huang, Wei, et al., 2007).

Time	Forecast load(MW)	Actual load(MW)	Relative error(%)
01: 00	1865	1833	1.71
02: 00	1778	1762	0.90
03: 00	1783	1753	1.68
04: 00	1760	1728	1.82
05: 00	1780	1763	0.96
06: 00	1861	1885	1.29
07: 00	2008	2106	4.88
08: 00	2137	2140	0.14
09: 00	2310	2345	1.52
10: 00	2350	2370	0.85
11: 00	2470	2464	0.02
12: 00	2390	2332	2.43
Average accuracy of daily forecast(%): 98.48			
Daily maximum load:2470	Actual value:2464	Accuracy rate(%): 99.98	
Daily minimum load:1760	Actual value:1728	Accuracy rate(%):98.18	

Table 1 – Daily Load Forecasting Data

4. Conclusions

With the development of electric power market, the importance of load forecasting is becoming more and more important, it has become an important content to realize the modernization of power system management, and the requirement of load forecast is higher and higher. Based on the understanding of the development of China's power industry, the modern prediction techniques of classical techniques based on the measurement of electrical load forecast data with computer precise optimization algorithm mainly include the method of artificial neural network, fuzzy

prediction method and grey prediction method, expert system prediction method, wavelet analysis method and data mining technology. Through the experimental analysis, it is found that the prediction method established in this paper has a good forecast effect, which can forecast the daily load of electric power system accurately.

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Credit Risk Assessment Model of SMEs Based on Multi-Level Fuzzy Comprehensive Evaluation- A Leather Factory in Wenzhou as an Example

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Abstract: Objective: The commercial bank credit conditions for small and medium-sized enterprises can not meet the needs of the development of small and medium-sized enterprises. Based on this, the establishment of evaluation system of small and medium sized enterprises credit risk was carried out based on multi-level fuzzy comprehensive evaluation. Methods: The analytic hierarchy process and fuzzy comprehensive evaluation method. Process: With the combination of the analytic hierarchy process and fuzzy comprehensive evaluation, SME credit risk assessment was put forward. A Wenzhou leather company was taken as a example for the credit risk evaluation. Result& Analysis: The basic quality of the enterprise macro industry environment and enterprise has a very important role in enterprise credit evaluation. Result: The algorithm could be applied to credit risk comprehensive evaluation of credit for small and medium-sized enterprises in a certain extent.

Keywords: Small and medium enterprises; credit risk evaluation; multi-level fuzzy algorithm.

1. Introduction

In recent years, small and medium enterprises gradually active, and has become an important factor for sustainable development and social and economic prosperity and stability. Commercial banks pay more attention to the small and medium-sized enterprise also gradually deepened, to set up specialized agencies for loans of small and medium enterprises. Due to the small and medium-sized enterprise without corporate rules and norms, corporate culture and information transparency, between commercial banks and small and medium-sized enterprises often exist information asymmetry and, academia and the industry generally believe that the information asymmetry between banks and SMEs often makes commercial banks face a greater risk of operation, so commercial banks in loans to small and medium enterprises tend to err on the side of caution. In recent years, the domestic and foreign research on the credit risk of small and medium-sized enterprises in deepening. Dietsch and Petey (2002) measure the VaR in French loans to small and medium-sized enterprises, and according to the New Basel Capital Accord to calculate the corresponding venture capital, that borrowers limited information (limited information) to the credit risk of the larger (Paşca, G., Sorin,

I., Andrada, I., Bumbu, A., & Purza, L., 2015). Altman and Gabriele (2007) should be small and medium-sized enterprise credit by corporate loans turn for the retail loan, while also increasing the small and medium-sized enterprise customer risk management tools and methods developed (Morna, A., 2015). Canales and NANDA (2012) that the agency problem and information asymmetry will have important effects on (Iova, S., Pasca, G., Iova, A., Bumbu, A., & Purza, L., 2015) to the small and medium-sized enterprise credit risk. Guo Xiaobo (2009) that small and medium-sized enterprises has certain particularity, so in the credit risk assessment cannot be directly used for large enterprises of the evaluation index, the key index is mainly reflected in the non-financial information, such as employee number (Abubakar, A., Uzairu, A., Ekwumengbo, P. A., & Okunola, O. J., 2015). Zhou Zhongsheng and Wang Su (2010) for small and medium-sized enterprises credit "embedded" and "indirect embedding" of (Nodehi Moghadam, A., Goudarzian, M., Azadi, F., Hosseini, S. M., Mosallanezhad, Z., Karimi, N., ... & Yaghmaei, P., 2015). Xin Long Wang (2012) analysis the long Thai Farmers Bank "credit factory" model, and that the mode of small and medium-sized enterprises credit risk management has an active role in (Bejares, M., Oyarzún, A., Lucero, Y., Espinosa, N., Bascuñán, K., & Araya, M., 2015). In terms of research methods, Guo Xiaobo (2011) using binary logistic regression analysis was used to study the credit risk of SMEs, and this method as the foundation, screening the SME credit risk assessment of key variables (YUAN, L., GUO, S., CAO, Y., HAO, J. Y., & ZHANG, L. W., 2015). Xia Liming (2011) in the definition of the concept of supply chain finance based, from the perspective of bank established SME credit risk evaluation index system, using grey hierarchical analysis method and a threshold method, is established based on the assessment of supply chain finance of small and medium sized enterprises credit risk pricing model (Chavda, B. A., Sakariya, K., Trivedi, R. S., Sorani, A., Savaliya, C., Kakaiya, M., & Pithadia, P., 2015). Liangqi (2012) in 2005 to 2009 be conducted for the first time in st of small and medium-sized listed companies as the research object, comprehensive utilization of the financial index and the index of corporate governance and the extreme value sample robust logistic regression to construct a financial failure warning model (Lilai, X., Yuanrong, H., & Wei, H., 2016). Hu Haiqing (2012) by using machine learning method support vector machine (SVM) credit risk assessment model was established, and by using BP neural network algorithm is applied to establish the credit risk evaluation model were compared. The results show that under the condition of small sample, the credit risk assessment model based on SVM is more effective and superior (Taylor, A. A., & Byrne-Davis, L. M., 2016).

In recent years, fuzzy comprehensive evaluation method has been paid more and more attention, fuzzy comprehensive evaluation method, considering the characteristics of fuzzy variables, the qualitative variables and quantitative variables comprehensive analysis, multivariable fuzzy components can be treated effectively. In the specific evaluation process, the method based on fuzzy set membership function, on the relationship between the variables and the variables of mathematical operations, thus established to reflect the evaluation of the essence and characteristics of the evaluation objects. For small and medium-sized enterprise credit risk, due to the presence of a variety of qualitative and quantitative criteria, the influence of various factors on the credit risk are not the same. Therefore, the fuzzy comprehensive evaluation method is a kind of effective method. Also, the various factors influence of credit risk with different levels of structure. In credit risk assessment, from the sub indicators gradually transition

to the total index, using different levels of risk index fuzzy comprehensive evaluation method for multi-level fuzzy comprehensive evaluation method. By using the multi-level fuzzy comprehensive evaluation method can get the results of credit risk evaluation of small and medium sized enterprises (Giesen, E., 2015).

Based on this, this paper uses multi-level fuzzy comprehensive evaluation method of the to evaluate the credit risk of SMEs, this method can effectively deal with small and medium sized enterprises credit risk assessment in the process of qualitative and quantitative factors, evaluation index and evaluation method are combined effectively. In this paper, the construction of SME credit risk assessment of multi-level fuzzy comprehensive evaluation model, multilevel fuzzy comprehensive evaluation model of credit rating of the example analysis. The method can effectively deal with small and medium sized enterprises credit risk assessment in the process of qualitative and quantitative factors, evaluation index and evaluation method are combined effectively.

2. Factors of Credit Risk Evaluation of Small and Medium Sized Enterprises Set

The influence factors of small and medium-sized enterprise credit risk evaluation is set of SME credit risk variables. These variables can be divided into a factor set, two sets and three sets of factors. Level set of factors is first grade indexes, secondary factors set is the second grade indexes, three factors set three evaluation indexes. A set of factors is $U = \{U_1, U_2, \dots, U_m\}$; two factors set: $U_i = \{U_{i1}, U_{i2}, \dots, U_{im}\}$; three factors set: $U_{ij} = \{U_{ij1}, U_{ij2}, \dots, U_{ijm}\}$. Wherein, i for credit risk evaluation of the i -th factor; J for credit risk evaluation of the j -th secondary factors; m for credit risk evaluation of the three m level factors (Li, C., Zhang, K., Wang, Y., Guo, C., & Maggi, F., 2016).

Through the literature analysis method and interview method to determine the risk evaluation index, after repeated deliberation, established the eventual credit risk evaluation index system. Index system is divided into three levels of evaluation index: six evaluation indexes of first class as a level factor set; thirteen secondary evaluation index for the second level factor set; 36 third level indicators of the evaluation index system for Level 3 factors set. The six evaluation indexes of first class were: industry macro environment, the enterprise's basic quality, management level, financial evaluation, technical innovation and performance. Unlike previous SME credit risk assessment, credit risk of the combination of the index system of qualitative index and quantitative index and subjective index and objective indexes, it can be more comprehensive, objective and effective evaluation of small and medium-sized enterprises. At the same time overcome in the small and medium-sized enterprise credit evaluation process, the problem caused by asymmetric information.

2.1. Macro Industrial Environment

Every enterprise in a certain market, the risk of each market has its inherent. Small and medium-sized enterprises in the industry, the country's industrial policy is also different. In view of the small and medium-sized enterprises in solving the employment and promote the important role in the development of national economy, the country is gradually perfect policy support for small and medium-sized enterprises. More sensitive

to changes of small and medium-sized enterprises on the market so we need for small and medium-sized enterprises of the industry. Especially, in the long-term development trend and enterprise market segments where judgment, analysis of the impact it had on the operation and development of enterprises. Consider the possible changes in the industry life cycle, the degree of competition, industry profit sources and risk, market and technology progress in the analysis of industry macro environment of industry overall impact (Carvalho, A. A., Araújo, I., & Fonseca, A., 2015).

2.2. Basic Quality of Enterprises

Comprehensive evaluation of basic quality of enterprise and mainly analyzes the enterprise of enterprise. The basic quality of the enterprise is one of the basic content of the enterprise, but also directly reflects the credit status of the enterprise. The main factors analysis of enterprise scale, the quality of management, enterprise staff quality, management level and asset quality etc.

2.3. Management Level

At present, many domestic enterprises success often depends on the management level of management level, small and medium-sized enterprises, even more so. Therefore, evaluation of management is the main contents of the credit evaluation. Evaluation of the level of management mainly includes the analysis of two aspects of management quality and management ability.

2.4. Financial Evaluation

Fundamentally speaking, the financial situation of enterprises determines the credit foundation of enterprises, enterprises must take the financial guarantee for credit. Therefore, the analysis of enterprise financial situation is an important link in the enterprise credit evaluation. Based on the level of small and medium-sized enterprises accounting the universal truth, the judgment of the financial risk mainly rely on enterprise accounting statements, accounting statements are true and reliable determines the judgment accuracy. The SME credit evaluation mechanism on the small and medium-sized enterprise accounting statements to carefully identify and in determining the authenticity of the financial report, focuses on the evaluation of the debt paying ability of small and medium-sized enterprises, profitability, small and medium-sized enterprises are generally lack of fixed assets, thus, it is necessary to pay more attention to the flow rate of return on assets.

The rate of assets and liabilities: $\text{asset liability ratio} = \frac{\text{Total Liabilities}}{\text{total assets}} \times 100\%$. The index is an important index for measure of corporate debt repayment capacity and financial risks of internationally recognized, reflecting the is a corporation's long-term debt paying ability. High rates of assets and liabilities that a high degree of enterprise operating liabilities, financial risk of large, long-term debt paying ability weak "but assets and liabilities rate is not the lower the better. It is generally believed that 60% is a good level.

Flow rate: $\text{liquidity ratio} = \frac{\text{current assets}}{\text{current liabilities}} \times 100\%$, is an important index to reflect the enterprise short-term debt paying ability. Generally speaking, flow rate is high, indicating that the enterprise current assets to current liabilities higher

level of protection, the enterprise short-term debt paying ability is stronger. Generally believed that the enterprise normal flow ratio reached 150% above can effectively protect the creditor's interests, if less than 125%, enterprise debt paying risk will increase.

Ratio of cash: cash ratio of enterprise monetary fund balance / current liabilities X100%, which the ratio of the monetary fund balance and total current liabilities of corporate can use balance sheet in the beginning and end of the year the average balance or the 12 months before the average balance. This ratio reflects the enterprise liquidity can be used immediately for the solvency of current liabilities.

Sales profit rate of sales profit rate = gross profit / X100% of sales revenue, the reflection is enterprises realize the profit in sales revenue accounted for the proportion of the sales profit rate is higher, indicates a stronger corporate profitability and better economic benefit. Corporate profits and sales revenue in the same direction growth and profit growth rate should be higher than sales growth rate, to illustrate the benefit of enterprise. Close to 15% of the ideal sales profit rate are better.

Return on assets: rate of return on assets = pre tax profit / total assets of X100% is reflect the enterprise including index of net assets and liabilities, including all the assets of the effect of comprehensive utilization, to measure the enterprises to take advantage of the creditors and owners' equity total earnings ratio. The higher the rate of return on total assets, the total assets of the enterprise operating efficiency better, stronger profitability.

Ratio of profits to cost: cost profit rate = gross profit / cost of the total cost of the X100%, reflecting the relationship occurring in the process of enterprise production and management cost and the income. Cost profit rate is a direct reflection of revenue and increase savings benefit index. The higher the ratio, indicates that the enterprise gains made higher cost.

Current asset turnover: the turnover rate of current assets = sales revenue / average assets. Reflects the corporate liquidity operation. The current assets turnover rate is high, enterprise more with less money for enterprises to provide more products, its operating ability is stronger.

Accounts receivable turnover ratio, accounts receivable turnover rate = core business net income / average accounts receivable. Should the accounts receivable turnover rate reflects the enterprise accounts receivable of flow velocity, namely the enterprise the annual accounts receivable turn for the average number of cash.

Inventory turnover rate of inventory turnover rate of cost of sales / average inventory balance. Among them, the average inventory balance = Inventory (early number + inventory at the end of the number) / 2. The inventory turnover rate is high, stock liquidity is bigger. So in general, the higher the index, said corporate assets due to the sale of the smooth and has high liquidity, inventory conversion into cash or shall be accounts receivable are fast, and the occupation of inventory level is low.

Turnover ratio of total assets. The total asset turnover ratio refers to the sales income and average total assets. The calculation formula is as follows: the total asset turnover = sales revenue / average total assets of x100%. The index to reflect the total assets turnover rate. The faster the turnover, reflecting the ability to sell more, asset utilization rate is high, the increase in the absolute amount of profit.

2.5. Technological Innovation

Technology innovation has become an important condition for the survival and development of enterprises, is a foundation for the survival of enterprises, companies have to constantly innovate to in market competition to occupy a place. Therefore, the evaluation of enterprise innovation capability is also undoubtedly should be as an important aspect of corporate credit rating. The evaluation of technological innovation capability innovation from two aspects: research and development level of quality.

2.6. Performance Status

The performance status in the history of enterprises of small and medium sized enterprises credit rating is also a factor that can not be ignored. The performance of enterprise can not only reflect the solvency of enterprises, but also reflect the enterprise's willingness to repay. Therefore, in the credit rating of small and medium-sized enterprises, the performance situation of the enterprise is very necessary. A measure of enterprise performance status mainly from the bank credit and business credit status analysis (Izhar, S., Goel, A., Chakraborty, A., & Gupta, T., 2016).

First level evaluation index	Two level evaluation index	Three level evaluation index	Index content
<i>Macro industrial environment A1</i>	Industry status B1	Market concentration degree C1	Market size enterprise sales proportion
		Market entry barriers C2	Entry barriers are high and low
		Development cycle C3	Emerging, mature or declining market
		Policy support C4	Encourage development, restrict development, clean up and rectify
	Market competition B2	Market alternative C5	Alternative product quantity and replacement cost
		Market share C6	Company sales / industry sales
		Supply chain stability C7	Raw material price fluctuation, supplier Bidding Ability
<i>Enterprise basic quality A2</i>	Enterprise quality B3	Total assets C8	Reflect the operating scale and property rights of enterprises
		Sales revenue C9	
		Corporate governance structure C10	
	Staff quality B4	Age structure C11	Reflect the situation of human resources in Enterprises
		Cultural and technical conditions C12	

<i>Management level A3</i>	Management quality B5	Manager Analysis preference C13	Risk preference, aversion, and neutrality
		Leader's quality and ability C14	Good, medium and poor
		Management team building C15	Qualitative index
	Operating capacity B6	Division power division C16	Qualitative index
		Marketing ability C17	Qualitative index
		Sales channel control C18	Qualitative index
<i>Financial evaluation A4</i>	Solvency B7	Asset liability ratio C19	Quantitative index
		Flow ratio C20	Quantitative index
		Cash ratio C21	Quantitative index
	Profitability B8	Sales profit margin C22	Quantitative index
		Return on assets C23	Quantitative index
		Cost, cost profit margin C24	Quantitative index
	Asset operation capability B9	Turnover rate of current assets C25	Quantitative index
		Accounts receivable turnover rate C26	Quantitative index
		Inventory turnover rate C27	Quantitative index
		Total asset turnover rate C28	Quantitative index
<i>Evaluation of technological innovation A5</i>	R & D quality B10	R & D personnel proportion C29	On behalf of enterprise investment in human capital
		R & D personnel level C30	The key to the competitiveness of enterprises
	R & D level B11	R&D input strength C31	Enterprise R & D investment
		R & D Level results C32	High, medium and general
<i>Performance status A6</i>	Bank credit B12	The principal and interest of the loan repayment rate C33	Quantitative index
		Payment rate of the loan on schedule C34	Quantitative index
	Business credit status B13	Tax evasion default behavior C35	The amount of tax evasion, deadbeat motivation
		Contingent liability C36	Pending litigation, guarantees, etc.

Table 1 – Evaluation Index System

3. Effect of Sme Credit Risk Assessment Calculation Factor Set

3.1. Determination of the Weight of Index

This paper uses AHP to determine the weights of evaluation indexes at all levels. This method in the calculation process, through the expert evaluation to evaluate index of relative importance to determine the weight of each index. If the sum of the weight of each index is 1, the U_{ijk} of the weight of U_{ij} is a_{ijk} , then:

$$\sum_{k=1 \sim m} a_{ijk} = 1 \quad (1)$$

U_{ij} of the weight of U_i is a_{ij} , then:

$$\sum_{j=1 \sim n} a_{ij} = 1 \quad (2)$$

U_i of the weight of U is a_i , then:

$$\sum_{i=1 \sim p} a_i = 1 \quad (3)$$

Wherein, the P, N, m respectively are the number of first grade indexes, two level indexes and three level evaluation index.

3.2. Determine the Evaluation Set

Evaluation set may occur in credit risk assessment results, with L for SMEs credit risk rating results, with V to represent grade evaluation : $v = \{v_1, v_2, \dots, v_l\}$. In this paper, the small and medium-sized enterprise credit risk rating is divided into nine grades according to the risk from high to low for: $v = \{\text{AAA}, \text{AA}, \text{A}, \text{BBB}, \text{BB}, \text{B}, \text{CCC}, \text{CC}, \text{C}\}$ (Mahishale, V., Angadi, N., Metgudmath, V., Eti, A., Lolly, M., & Khan, S., 2015).

3.3. The Fuzzy Judgment Matrix the Establishment of Sme Credit Risk Assessment

Look for factors focused on the various elements of the alternative membership relationship between concentration of each element, the establishment of membership function and each factors constitute a fuzzy evaluation vector $R = (r_{i1}, r_{i2}, \dots, r_{in})$, all the single factor fuzzy vector form factor fuzzy judgment matrix. The method of determining the membership index, according to the index is a qualitative index or quantitative indicators vary (Alkhalidi, G., Hamilton, F. L., Lau, R., Webster, R., Michie, S., & Murray, E., 2016).

Because of difficult to quantify the qualitative index, so the traditional expert evaluation method. According to the evaluation set $V = (\text{AAA}, \text{AA}, \text{A}, \text{BBB}, \text{BB}, \text{B}, \text{CCC}, \text{CC}, \text{c})$, was asked ten experts (four for bank credit staff, four research for colleges and universities to, two for credit rating intermediary personnel) refer to the qualitative indexes of

various grades of reference standard for the index layer D in the evaluation of the factors relative to the upper layer one factor classification and statistical factor Di classified as the frequency of each grade, you can get the membership vector of evaluation index Di.

Quantitative indicators can be directly used to represent the number, it can be used to calculate membership function. First by the number of participating experts according to their own long-term practical experience, combined with industry characteristics and industry characteristics for each quantitative indicators give different ranges, which take the value, so that after repeated modified by grading standards of each index.

	AAA	AA	A	BBB	BB	B	CCC	CC	C
D_1	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}
D_2	X_{21}	X_{22}	X_{23}	X_{24}	X_{25}	X_{26}	X_{27}	X_{28}	X_{29}
D_3	X_{31}	X_{32}	X_{33}	X_{34}	X_{35}	X_{36}	X_{37}	X_{38}	X_{39}
...	...	...	...	...	...	...	...	...	...

Table 2 – Classification Criteria of Evaluation Index

If membership function of various factors on the credit rating change according to the linear, then for index size and credit level was positively correlated with positive indicators, membership of the grade I press type calculation.

$$u(x) = \frac{x - x_i}{x_{i+1} - x_i} \quad x_i < x < x_{i+1} \quad (4)$$

The index value and the enterprise credit level is negatively related to the reverse index, the I membership degree can be calculated according to the formula:

$$u(x) = \frac{x_{i+1} - x}{x_{i+1} - x_i} \quad x_i < x < x_{i+1} \quad (5)$$

3.4. Calculation of Comprehensive Evaluation and Comprehensive Evaluation Value Vector

$$P = VR = (P_1, P_2, P_3, \dots, P_9) \quad h(6)$$

In order to make the results more comprehensive quality level is easy to distinguish the introduction of fractional set:

$$F = (F_1, F_2, F_3, \dots, F_9)^T = (90, 80, 70, \dots, 10)^T \quad (7)$$

Wherein, r_j is the class J rating score. Therefore, small and medium-sized enterprise credit grade evaluation value for Z=FP to obtain credit evaluation of enterprise value,

enterprise industry in line with national policy under the premise, the control reviews of small and medium enterprises credit rating scale (Table 3), which is the results of final evaluation of enterprise credit rating.

Credit score	Level	Meaning
100-90	AAA	Short term debt payment capacity and long-term debt repayment capacity has the greatest guarantee; operating in a virtuous cycle, the impact of uncertainty on the operating and development of the smallest
90-80	AA	Short term debt payment ability and long-term debt repayment ability is very strong; operating in the good state of the cycle, the impact of uncertainty on the management and development is very small
80-70	A	Short term debt payment ability and long-term debt repayment ability is stronger, enterprise management in a virtuous cycle, the future operation and development of the enterprise is vulnerable to the impact of internal and external factors, and the profitability and solvency may produce fluctuations
70-60	BBB	The short-term debt paying ability and long-term debt repayment ability, the principal security is appropriate. The operation of the industry is in a positive cycle, and the future operation and development is affected by the internal and external factors of the enterprise. Profitability and solvency will have greater volatility, the agreed conditions may not be sufficient to protect the safety of principal and interest.
60-50	BB	Short term debt payment ability and long-term debt repayment ability is weak, the enterprise management and development situation is not good, the ability to pay is not stable, there is a certain risk.
50-40	B	Short term debt payment ability and long-term debt repayment ability is poor, by the influence of internal and external uncertainty, enterprise management is more difficult, the ability to pay a greater uncertainty, the risk is greater.
40-30	CCC	Short term debt payment ability and long-term debt repayment ability is very poor. Affected by internal and external uncertainties, business difficulties, the ability to pay is very difficult, a lot of risk.
30-20	CC	Short term debt payment ability and long-term debt repayment ability serious shortage, poor operating conditions, to promote enterprise business and development into a virtuous circle of internal and external factors, the risk is great.
20 points below	C	Short term debt payment difficulties, long-term debt repayment ability range. Business situation has been bad, basically in a vicious circle, the enterprise is on the verge of bankruptcy.

Table 3 – Credit Rating of Small and Medium Sized Enterprises

4. Application of Multi Level Fuzzy Comprehensive Evaluation in the Credit Evaluation of Small and Middle Enterprises



Figure 1 – Tannery in Wenzhou

This study selected a Wenzhou leather company as the research object. For credit risk evaluation of the enterprise reference in this paper (Table 1) credit risk investigation on the collection of data processing. The results obtained are as follows:

SME credit risk evaluation indexes weights:

$$WB_1=(0.2725,0.2725,0.1826,0.2725);$$

$$WB_2=(0.2693,0.4018,0.3289);$$

$$WB_3=(0.3314,0.2900,0.3786);$$

$$WB_4=(0.3543,0.6457);$$

$$WB_5=(0.3458,0.4224,0.2318);$$

$$WB_6=(0.2473,0.3021,0.4506);$$

$$WB_7=(0.3289,0.4018,0.2693);$$

$$WB_8=(0.2864,0.4272,0.2864);$$

$$WB_9=(0.2749,0.2749,0.2251,0.2251);$$

$$WB_{10}=(0.3543,0.6457);$$

$$WB_{11}=(0.6457,0.3543);$$

$$WB_{12}=(0.5000,0.5000);$$

$$WB_{13}=(0.5498,0.4502);$$

$$WA_1=(0.5498,0.4502);$$

$$WA_2=(0.5498,0.4502);$$

$$WA_3=(0.5,0.5);$$

$$WA_4=(0.3289,0.4018,0.2693);$$

$$WA_5=(0.3543,0.6457)$$

$$WA_6=(0.5,0.5)$$

$$W_U=(0.1465,0.0804,0.2114,0.3982,0.0804,0.0831)$$

Membership based on the data collected from three factors calculated 36 sets, obtained the corresponding fuzzy judgment matrix. A fuzzy comprehensive evaluation, comprehensive evaluation of the two level evaluation index vector. Again according to the comprehensive evaluation of the secondary evaluation index vector and the corresponding evaluation index weights, two grade fuzzy comprehensive evaluation, and obtained the comprehensive evaluation of the level of evaluation index vector. Finally, using level evaluation index of comprehensive evaluation vector, three level fuzzy comprehensive evaluation and obtained the final comprehensive evaluation vector is:

$$P:(0.364,0.216,0.214,0.106,0.032,0.036,0.028,0.004,0)$$

Comprehensive evaluation of credit rating of small and medium-sized enterprises value: $Z=PF$, is a comprehensive evaluation of the credit rating of the leather goods company scores:

$$Z=(0.364,0.216,0.214,0.106,0.032,0.036,0.028,0.004,0)*(95,85,75,65,55,45,35,25,15)$$

$$T=80.86$$

With reference to the small and medium-sized enterprise credit rating reviews table (Table 3), and the leather goods company's credit rating to AA, the solvency and profitability of enterprises is very strong; at the same time the management level of enterprises rating companies do great contribution. Thus it can be seen that in the credit risk assessment, the basic quality of the enterprise of industry macro environment and enterprise for the enterprise credit evaluation has a very important role. So for the credit risk assessment of small and medium-sized enterprises should fully consider the actual situation of small and medium-sized enterprises, the use of more reasonable evaluation model on the is more comprehensive and reasonable credit rating.

5. Conclusions

Due to the small and medium-sized enterprise information is opaque, asymmetry and other characteristics, using the traditional large-scale enterprise credit evaluation method, commercial banks is difficult to effectively control the credit risk. The analytic hierarchy process and fuzzy comprehensive evaluation by the method combined and applied to the SME credit risk assessment, using literature method, interview method and constructed a set of evaluation index system of the SMEs credit risk assessment for. The system is divided into three grades, a total of 36 level three indexes. The evaluation index covers enterprise, also have the familiar financial analysis index and quantitative index, at the same time, including the macro environment, the quality of enterprises and other qualitative indicators. The method could be applied to credit risk evaluation of comprehensive credit for small and medium-sized enterprises in a certain extent.

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Analysis and Research on Seismic Damage Index of Reinforced Concrete Intake Tower Structure

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Abstract: Objective: intake tower plays an important role in hydropower station, and the seismic safety of the inlet tower structure is not only to maintain the normal operation of hydropower projects, but also to ensure the safety of hydropower projects will have a great impact, so it is very important to study the seismic performance and seismic damage index. Methods: in this paper, the model of the target displacement and the loading mode of the top of the tower are analyzed by using the frame element and the layered shell element respectively. Process: through regression analysis of the data, the relationship between the stiffness degradation coefficient and the strength degradation coefficient of the damaged member and the numerical value of the component damage index is obtained. Then, the overall damage index of the structure and the seismic performance and damage index are calculated by the Park-Ang damage model. Results: the numerical analysis shows that the method can accurately estimate the damage index. Conclusion: this method can be more accurate in the evaluation of damage estimation.

Keywords: Seismic performance, damage index, pushover analysis, damage model.

1. Introduction

The intake tower structure is in the inner and outer water body, and it is a very important problem in the earthquake. Tower body subjected to earthquake disaster process easy formation of cracks and deformation and failure, due to the ground with the tower body materials and different stiffness, earthquake of intake tower bottom, side wall and the foundation of the contact surface to produce tensile stress may lead to the separation of tower body and foundation. The structural characteristics of the intake tower is generally used in the reinforced concrete thin wall hollow tower structure, built in close to the shore of the reservoir, the top of the bridge with the river bank. To prevent or mitigate earthquake damage, improve the structural seismic capacity, improve and strengthen the structural structure, usually referred to as seismic measures. In the traditional structure, the plastic deformation energy and hysteretic energy dissipation of the main structural members are used to dissipate seismic energy. This makes the energy consumption performance of these regions become particularly important. Once some factors cause the problem, the seismic performance of the structure will be seriously

affected. Because the damage location is located in the main structural members, the repair is very difficult to carry out (Zhao Y., Wang F., 2015).

In 1990, the American scholars and engineers proposed the performance-based seismic design theory is based on the type of structure and seismic fortification level, with displacement, ductility or energy and other parameters as the performance objective, through the elastic plastic seismic design, so that the structure of the response to meet the expected seismic performance objectives (Wilson T H., Hart A K., Sullivan P., 2015). Japanese scholars in the following the United States is proposed based on the structure and properties of seismic design theory, especially after the Kobe earthquake in 1995, huge economic loss make people realize based on the bearing force theory of defects (Gooley D., 2015). Started a 3 year "building structure of modern engineering method development" research, the project aims to establish a performance based structure engineering method, the theory itself and the practical application value of the project is widely discussed and studied (Fanaie N., Shamloua S O., 2015). In 1995, Kowalsky M J directly target displacement, damage degree as the target of structure design, for the first time systematically proposed pier directly design method based on displacement, structure stiffness and bearing capacity are by target displacement to determine; Pualay T in 1998, the more clear the thinking based on the displacement based seismic design method is proposed for the multi degree of freedom structure "direct displacement based seismic design method; in 2006, is proposed for free vibration analysis of structure and elastic displacement of the structure of each mode combination, calculate the structural displacement curve, the realization of the considering higher modes influence type directly based on the displacement of seismic design (Higuera V., Amezcua-Guerra L M., Montoya H., 2015; Raouffard M M., Nishiyama M., 2015; Estêvão J M C., Carreira A S., 2015). Capacity Spectrum Method was proposed in the early 1975 by the S A Freeman in the US Navy engineering. This method has gradually developed into a static analysis method (Pushover analysis method). The basic idea of capacity spectrum method is to transform the relationship curve between acceleration and displacement, which is based on the standard response spectrum or single degree of freedom elastic response spectrum, which is the curve of the bottom shear force and displacement of the structure model (Nascimbene R., 2015).

The development of seismic evaluation theory based on the performance of building structure is based on a large amount of seismic data, and every time the earthquake has exposed the defects of the current or past seismic design or assessment theory, and the seismic evaluation theory and seismic design theory is gradually developing. (Cadavid, J. M., & Gómez, L. F. M., 2015) For building structural seismic design, the seismic intensity is known, and the process of seismic design is to determine the seismic load bearing capacity and deformation capacity, and the structural seismic performance evaluation is just the opposite of seismic design. It can be seen that the seismic evaluation of building structure is consistent with the idea of building structural seismic design. The primary problem of seismic performance evaluation of reinforced concrete structures is to determine the load input of the model, which mainly includes the structural load (dead load and live load) and the earthquake as well as the structural load (dead load and live load) (Mahesh M J., Das R., Soumya S A., 2015). For the structural load, it has the characteristic of time variation, because of the random variation of the structure, the probability distribution of the maximum load in the load design reference period should be considered. For different design reference periods, the maximum load probability

distribution is different, and the load value should be different. However, the value of earthquake action for the seismic evaluation of structures, which is more uncertain than the conventional load, has a greater impact on the structure. Therefore, it is necessary to study the seismic action of the structure in the follow-up period. Considering the structure of earthquake damage is usually a structure which has been used for a period of time, these structures have been used to evaluate the seismic intensity of the earthquake intensity, which is considered as the structural residual service life (Radovanović S D., Brajović L M., Pavić M L., 2015; Krounis A., Johansson F., Larsson S., 2015; Pausz S., Nowotny H., Jung G., 2015).

The basic process of seismic performance evaluation of damaged reinforced concrete frame structures is established. The damage model and the value of earthquake action are described in detail. Through analysis, we get the following conclusions: 1. The earthquake damaged the structure of initial stiffness degradation value cannot determine the location and size of the damage constitutive; post yield stiffness degradation degree is bigger but post yield stiffness degradation of structure to the injury site is more sensitive, the structure damage in parts of the lower the corresponding damage node structure; 2. In this paper, we simplify the improvement of pushover analysis to better account of structure of high-order mode, used for earthquake damaged structure seismic performance evaluation and calculation results are accurate and reliable (Al-Suhaili P D R H S., Ali P D A A M., Behaya S A K., 2014; Mandal K K., Maity D., 2015).

2. Method Principle

2.1. Pushover Principle

Pushover analysis method is a kind of static elastoplasticity analysis method, which is a combination of reaction spectrum. It is a kind of process that the monitoring points of the structure can reach the target displacement or structure; the target displacement of structure under the action of design earthquake force of maximum deformation, thus monitoring generally take place in structure at the top of the centroid. The analysis method has two basic assumptions:

1. The structural response is mainly controlled by the first mode of the structure, and is related to the equivalent single degree of SDOF (equivalent single degree of freedom structure system);
2. The deformation of the structure along the height direction is controlled by the shape vector. Under the action of the earthquake horizontal inertial force, no matter how the structure is deformed, the shape vector remains unchanged.

The response mode of the multi degree of freedom system can be expressed by the mode vector $\{\phi\}$, and the relative displacement vector $X = \{\phi\}x_i$, where x_i is the top displacement of the multi degree of freedom system. Motion differential equation of multi degree of freedom system, such as formula 1:

$$[M]\{\phi\}x_i + [C]\{\phi\}x_i + \{Q\} = -[M]I x_g \quad (1)$$

Among them: $[M]$ and $[C]$ are the mass matrix and damping matrix of the structure; $\{Q\}$ for the structure of each layer of the restoring force vector, x_g is the earthquake ground acceleration.

Equivalent single degree of freedom system structure of displacement, such as formula 2:

$$x^* = \frac{\{\phi\}^T [M] \{\phi\}}{\{\phi\}^T [M] I} x_i \quad (2)$$

The above two formulas simultaneous:

$$M^* \ddot{x}^* + C^* \dot{x}^* + Q^* = -M^* \ddot{x}_g \quad (3)$$

Among them: quality, damping, lateral force and cycle were:

$$M^* = \{\phi\}^T [M] I \quad (4)$$

$$C^* = \{\phi\}^T [C] \{\phi\} \frac{\{\phi\}^T [M] I}{\{\phi\}^T [M] \{\phi\}} \quad (5)$$

$$Q^* = \{\phi\}^T \{Q\} \quad (6)$$

$$T_e^* = 2\pi \sqrt{M^* / K^*} \quad (7)$$

Among them: K^* is the stiffness of the equivalent single degree of freedom system.

Assuming that the vibration mode vector $\{\phi\}$ is known, the stress and displacement characteristics of the equivalent single degree of freedom system can be obtained by the nonlinear incremental static analysis of the multi degree of freedom system, and the V_b and the x_i of the base shear-force of the multi degree of freedom system can be obtained by the simplified load displacement curve, as shown in Figure 1. The equivalent base shear and displacement of the equivalent single degree of freedom system is obtained.

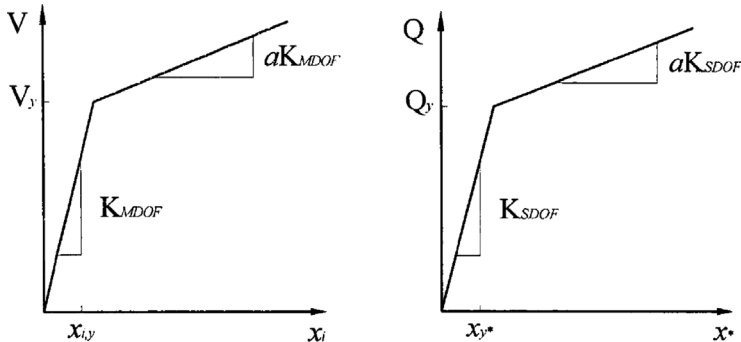


Figure 1 – The Force-Displacement Relationship of MDOF Structure and Equivalent SDOF System

2.2. Damage Index Estimation

The general method for estimating the structural damage index based on Park-Ang damage model is obtained by considering the maximum deformation and seismic energy dissipation. Park-Ang double parameter failure criterion was originally proposed for concrete members, and the expressions are as follows:

$$D = \delta_m / \delta_u + \beta \int dE / (F_y \delta_u) \quad (8)$$

In the formula, D , δ_m and $\int dE / (F_y \delta_u)$ are respectively the damage index, non-elastic deformation and cumulative energy consumption of the component. β as energy dissipation factor. The δ_u and $F_y \delta_u$ are respectively the ultimate deformation and the limit energy consumption of the members under monotonic loading. If the meaning is extended to the MDOFS structure, the two should correspond to the ultimate deformation of the structure and the limit of the total energy consumption. In view of the Pushover analysis is a monotonic loading of the whole structure, this chapter will be the ultimate deformation of the structure to the I analysis of the peak displacement limit value of Pushover u_{tmi} . The limit total energy dissipation of E_{ui} under monotonic loading is used to maintain the consistency of the $F_y \delta_u$ in the physical sense.

$$E_{ui} = Q_{yi}^T u_{mi} \quad (9)$$

A , B are the displacement vector and the limit total energy consumption of the structural collapse when the mode of vibration mode is pushed to the structure by i .

Q_{yi} is according to the first order modal I load model to structure the yield displacement restoring force vector.

$$u_{mi} = (\psi_i / \varphi_{1i}) u_{tmi} \quad (10)$$

$$Q_{yi} = (M \psi_i / \psi_i^T M I) V_{byi} \quad (11)$$

$$q_{yi} = u_{tyi} / (\Gamma_i \varphi_{1i}) \quad (12)$$

$$q_{mi} = u_{tmi} / (\Gamma_i \varphi_{1i}) \quad (13)$$

$$Q^* = V_{byi} / \Gamma_i \quad (14)$$

$$Q_{yi}^* = V_{bmi} / \Gamma_i \quad (15)$$

$$D_{ti}^* = \Gamma_i \varphi_{1i} S_{di} \quad (16)$$

The u_{tyi} , u_{tmi} , V_{byi} , V_{bmi} are respectively the structural analysis of the MDOFS structure in the I structure into the Pushover analysis of the peak displacement yield, vertex

displacement, base shear force, the base shear limit value. The concrete relationship diagram is shown in Figure 2:

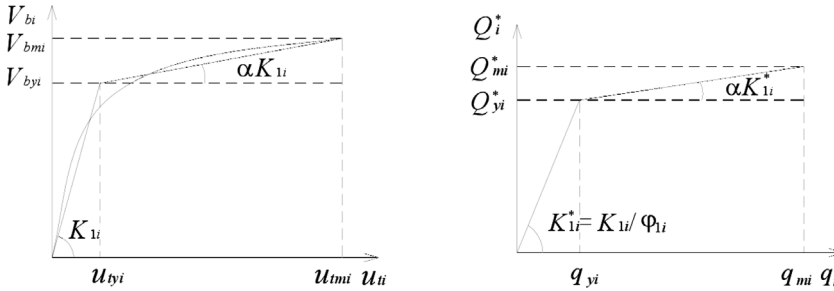


Figure 2 – The Relationship Between the base shear force (V_b) and the vertex displacement (U_t) and the Equivalent SDOFS Restoring Force Skeleton Curve.

Above the simultaneous equation:

$$E_{ui} = (u_{mi}^T Q_{yi})^T = \frac{\psi_i^T M \psi_i}{\phi_{1i} \psi_i^T M I} V_{byi} u_{tmi} = \frac{V_{byi} u_{tmi}}{\Gamma_i \phi_{1i}} \quad (17)$$

The formula E_{ui} is the MDOFS structure under monotonic loading limit the energy consumption under the conditions of Pushover analysis. Park-Ang damage criteria can be extended to the MDOFS structure, the expression is:

$$DI = DI_\delta + DI_E = D_t / u_{tmi} + \beta_I E_h / E_{ui} \quad (18)$$

In the form of DI , DI_δ and DI_E , the exact value of the integral damage index, the exact value of the integral damage index, and the exact value of the energy term of the whole damage index are proposed. β_I is an energy dissipation factor, which is caused by the damage of the structure, which can be considered as the same as the damage caused by the earthquake energy.

For seismic performance evaluation of seismic damage structure, the accuracy of its elastic-plastic analysis is higher, but it is also more complicated and less controllable, and more factors are considered in the same time. The damage effects of uncertainty in seismic analysis of structures in order to circumvent the reinforced concrete materials, it is hard to consider its own internal complex mechanical behavior and, sometimes through macro component of fitting the experimental data obtained from member damage recovery force model based on the level of material component recovery force model can better reflect the effects of some effects on the mechanical properties of the structure or component is a factor, such as reinforced concrete material of pinching slip phenomenon at the component level of structure damage constitutive relationship can be effectively avoid. In the earthquake damaged columns recovery force curve determined methods, some preliminary work was carried out, the through the analysis of vibration table simulation concrete members with flexure and axial force in the event of main-shock and aftershock earthquake under the action of mechanical properties test

results give the seismic damage of reinforced mixing concrete columns of the recovery force skeleton curve method to determine, and through two numerical cases analysis verified the method to determine the recovery force skeleton curve has certain accuracy and reliability, determine the specific steps:

1. Determine the undamaged component to restore the skeleton curve and the curve on the main characteristic parameter values: the yield displacement yield coordinate force (x_y, F_y) , limit displacement-ultimate strength of coordinate (x_u, F_u) , initial stiffness k_o , yield stiffness coefficient α and curve descending segment stiffness k_2 .
2. Determine the yield displacement of the damaged member x_{yd} . In determining the yield displacement of damaged structures, the random seismic response analysis of the original structure under given earthquake intensity is required in order to simulate the seismic action of the structure, and $x_{yd} = X_b$, where X_b is the average value of the displacement time history curve of reinforced concrete members under earthquake excitation.
3. Determine the yield strength of the damaged member F_{yd} :

$$F_y - F_{yd} = \frac{S_d \varepsilon}{x_y} \quad (19)$$

Among them, S is the strength degradation factor.

4. To determine the ultimate displacement of the damaged member x_{ud} , the ultimate displacement value of the damaged member is equivalent to the limit displacement value of the damaged member.
5. Assuming $F_u - F_{ud} = F_y - F_{yd}$, the ultimate strength of the damaged member is determined by F_{ud} and the stiffness of the skeleton curve is k_2 .

Flow chart is as follows:

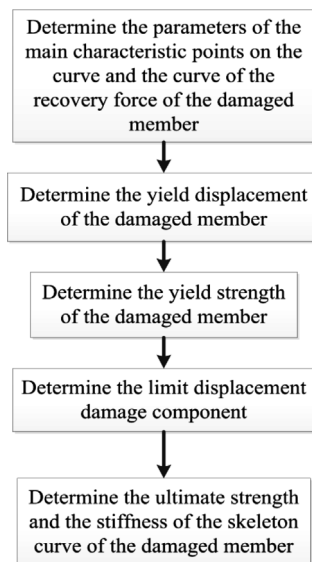


Figure 3 – The Flow Chart of the Restoring Force Skeleton Curve of Reinforced Concrete Material

3. Actual Data Validation

The damage of the damaged member is not convenient, and the engineering design personnel are mainly based on the seismic damage of the members. As mentioned above, the test results of this paper are mainly in the United States and Japan, so the corresponding relation between the damage degree and damage index of the frame structure is still used to divide the boundary points of the Park-Ang.

Damage grade	Damage description	Damage index DI
No damage	There are a few small cracks in the column, but not through	$DI < 0.1$
Minor damage	The concrete protective layer of the concrete protective layer is partially peeled off at the joint of the concrete cover.	$0.1 < DI < 0.25$
Moderate damage	There is a crack in the column end, and the concrete column appears partially exposed and crushed.	$0.25 < DI < 0.4$
Serious damage	Reinforced concrete column buckling, and the emergence of the phenomenon of caving	$0.4 < DI < 1$
Collapse	Member breaking	> 1

Table 1 – Damage Index Classification

The article carries on the test to the eight groups of data, the concrete data are as follows.

No.	Earthquake magnitude	$VS_{30}/(m/s)$	PGA/g	T_d/s
1	6.5	641	0.15	28.45
2	6.5	641	0.14	36.02
3	7.4	379	0.14	28.21
4	7.4	379	0.16	26.74
5	7.0	220	0.32	23.26
6	7.0	220	0.22	22.56
7	7.6	158	0.10	26.11
8	7.6	158	0.05	29.54

Table 2 – Test Data Table

Firstly, the dynamic time history analysis is performed to obtain the true story of the relationship curve of the true story. The following chart:

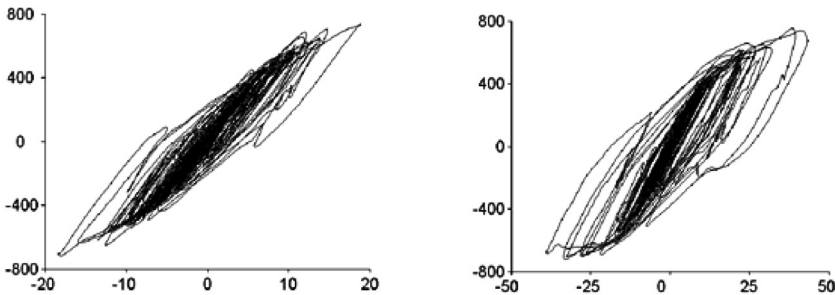


Figure 4 – Numerical Calculation Results of the Relationship Between the 1 and 2 Numerical Examples of the Structure of the Shear Force Displacement Hysteretic Relationship of the Bottom Layer

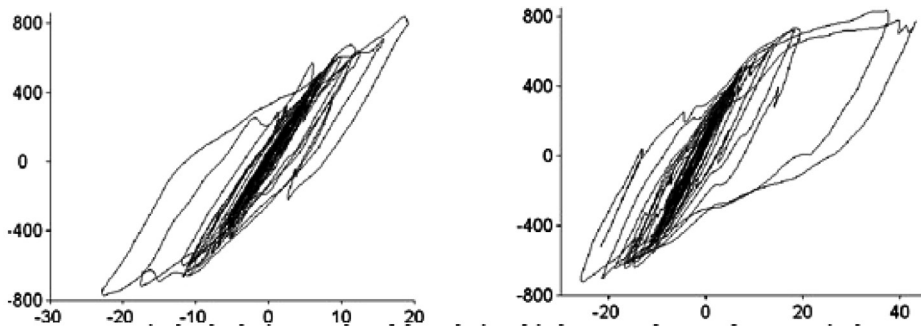


Figure 5 – Numerical Calculation Results of the Relationship Between the 3 and 4 Numerical Examples of the Structure of the Shear Force Displacement Hysteretic Relationship of the Bottom Layer

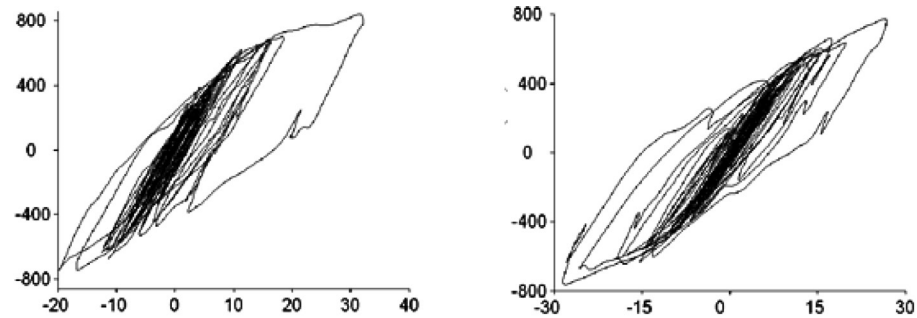


Figure 6 – Numerical Calculation Results of the Relationship Between the 5 and 6 Numerical Examples of the Structure of the Shear Force Displacement Hysteretic Relationship of the Bottom Layer

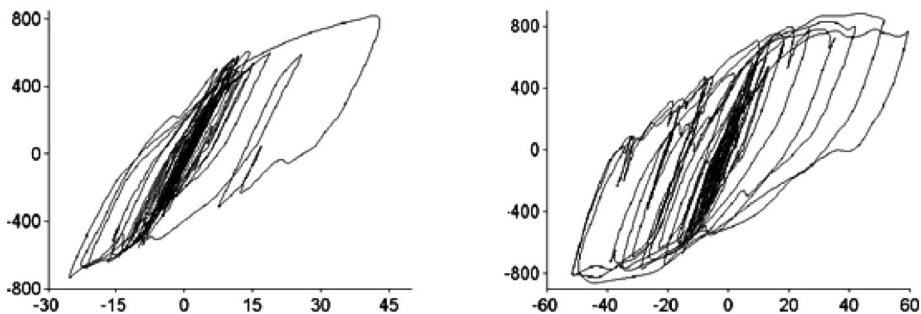


Figure 7 – Numerical Calculation Results of the Relationship Between the 7 and 8 Numerical Examples of the Structure of the Shear Force Displacement Hysteretic Relationship of the Bottom Layer

By using the time history analysis of the hysteretic curves, the damage index of the body is obtained by combining the formula 18. Such as Table 3:

No.	DI _δ	DI _E	DI	Deformation	Energy	Global change
1	0.234	0.084	0.332	3.834	7.578	5.212
2	0.482	0.254	0.634	5.721	4.827	2.211
3	0.482	0.064	0.534	4.734	4.677	4.613
4	0.391	0.055	0.444	4.173	9.231	2.344
5	0.310	0.043	0.322	9.034	7.610	8.875
6	0.524	0.111	0.628	7.178	7.270	7.181
7	0.496	0.078	0.576	7.754	8.439	5.638
8	0.667	0.257	0.979	3.312	10.142	0.731

Table 3 – The Structural Damage Index

Under the seismic action, if only considering the damage index deformation DI_{δ} calculation of the damage degree is slight, and energy after the damage index $0.4 < DI$ is less than or equal to 0.6, is difficult to repair the moderate damage. If we consider only the damage index DI_{δ} deformation, example concrete structure seismic demand estimation method to study the structure of the damage degree is medium, and energy after the injury index $0.6 < DI$ is less than 0.9, is serious damage can't be repaired. In case of damage index, the damage degree of DI is still serious, and the damage index of DI is over 0.9. It is found that the seismic performance of the structure is not safe. Therefore, the proposed method can be used to evaluate the seismic performance and damage index into the comprehensive evaluation of the Park-Ang model with the maximum deformation and cumulative damage. The results are more reasonable and safe.

4. Conclusions

Damage structure is different from that of the new structure, which is a great change in the risk level of earthquake load and the structural damage degradation model. According to the basic principle and general process of pushover analysis, the pushover analysis is carried out on the frame element and the layered shell element model. But the plastic hinge of the frame model is mainly concentrated on the hinge, and the bottom plastic hinge is in the ideal plastic stage, while in the process of continuing to push the structure is not new plastic hinge, the pushover curve is linear, and the layered shell element can directly reflect the nonlinear behavior of concrete and reinforced material. In this paper, the seismic performance evaluation of seismic damaged reinforced concrete frame structures is carried out in this paper. The three aspects are studied in this paper. The energy response of MDOFS structure under seismic action is analyzed, and the energy conversion relation between multi degree of freedom system and its equivalent single degree of freedom system is deduced based on Pushover analysis. On this basis, using the basic idea of the damage index of concrete members, the simplified calculation method of structural damage index based on Park-Ang model is proposed, which can be used to evaluate the seismic performance and damage index of the structure.

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Research on face recognition algorithm for data encryption virus

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Abstract: with the wide application of biometric identification technology, the security defects are gradually exposed. The encryption technology which was combined with Biometric cryptography and biometric identification technology is to compensate for lack of biometrics in terms of security caused. Based on the existing research of face biometrics technology, the face biometric encryption algorithm with security and fault tolerance was proposed: fuzzy random cyclic mapping. In each cycle, the use of encryption model is the key of the previous cycle as a random seed to generate a mapping matrix. The facial features of the user was mapped to formate a cyclic random mapping process. In the process of encryption, fault tolerant technology was used to reduce the effect of random noise and the characteristics of the legitimate users face image for recognition rate. The experiment showed that the biological characteristics of face encryption algorithm was in high security based on fuzzy random cyclic mapping.

Keywords: Fuzzy random cyclic mapping; face recognition.

1. Introduction

In recent years, biometric identification technology has been from the research phase to the application stage, and gradually shows great market potential. But with the development of application, some defects of biometric recognition technology itself is gradually exposed, which bring the most important is the biological characteristics related to personal privacy and security issues. The biological characteristics are the inherent people and cannot be changed, once stolen feature information is stored in the server, it will bring serious security problems. If the biometric recognition technology to large-scale application, it needs to have adequate security and confidentiality. The biometric recognition technology and encryption technology combines encryption technology can solve the above problems in a certain extent. In 1999, by the United States RSA laboratory Juel et al. Fuzzy theory is proposed based on the encoding theory and encoding mechanism will appoint cryptographic algorithm together, and the use of fault-tolerant technology to resist the influence of random noise in the password, to form a stable encryption key. In this scheme, encryption is divided into two parts: registration and certification (Chávez Gómez, L. A., López Herrera, A., & Parra Suescún,

J. E., 2015). At the time of registration, first extracted biometric binary representation, and the one with the random key binding error correcting codes, as the template stored in the server system. In the authentication phase, biometric authentication of a user through the template extraction, calculation of release key, if the two extraction of the biological features sufficiently similar key errors in the error correcting codes can be used to correct. But Juel did not realize are applied to specific biological characteristics and experimental data (CuiJuan, Z., & Kai, B., 2015). Fu Bo et al. Combined with FCS scheme is given the specific results, but the small number of samples, the results are not representative (Lior, L. Y., & Njoo, H., 2015). The use of feature fusion technology in facial feature extraction, the technology will be two different facial feature fusion has become a face vector. The experimental results show that when the same face authentication, can get very close to the feature vector (Onuorah, E. O., Okeke, C. A., Nwabanne, J. T., Nnabuike, E. L. C., & Obiorah, S. O. M., 2015). Zhang Xiangde et al use the neural network instead of Hamming code correction, can reach FRR=7.5%, the effect of FAR=2.46% (Harris, H. S., & McCloud, W., 2015). But the problem is the extraction algorithm of multiple images as samples both of them require authentication, reduces the practicality of the algorithm. On the other hand, although the rate of successful reconstruction key is very high, but they are likely to accept illegal user authentication, thereby reducing the safety.

Random space quantization using a transform can reproduce the facial feature map to random space, and in the key extraction after mapping space. The algorithm in addition to providing biological characteristics, also need a key mapping as a random seed, stored in the user token or input by the user can be the key. At the time of registration, use the key as a random seed to generate a set of pseudo random mapping matrix. Through the random mapping matrix N dimensional face feature mapping to P dimensional space ($P < N$). Finally, a threshold is used to discretize the face hash generating a binary value. In the test, using the same method to handle user samples, comparing the results with the original hash value between the Hamming distance(Kirschner, H., 2015). By changing the key can generate different templates. In the random space quantization of encryption algorithm, according to the report of Teoh, when the token and user characteristics are true, RMQ can achieve a very high recognition rate and error rate can be controlled at a very low level (Boston, R., 2016). Chen Nana used two yuan local mode (Local Binary Patterns, LBP) feature information extraction of the user, and then through the RMQ realize a facial feature encryption algorithm, and its application to the encryption system, the recognition rate can reach 99.6%, the error rate is 0.68% (Abubakar, A., Uzairu, A., Ekwumengbo, P. A., & Okunola, O. J., 2015). However, there are also disadvantages of the algorithm, namely the security of RMQ is based on token or key security. If an attacker obtains the user token, so even if he did not face features of the user, there is still considerable possibility through the authentication. (Gharagozlou, F., Saraji, G. N., Mazlumi, A., Nahvi, A., Nasrabadi, A. M., Foroushani, A. R. & Samavati, M., 2015).

Aiming at the existing defects and the practicability of the face encryption algorithms require more than one user of illegal users may have photos in the extraction of defects through the security verification, put forward the fuzzy random cyclic mapping algorithm. This algorithm is aimed at extracting only one user of face images, the recognition rate at

the cost of sacrificing a little to security strength enough to prevent illegal users through the authentication.

2. Biometric Encryption and Random Space Quantization

2.1. Biometric Encryption

The biometric encryption or Biometric Hashing is a kind of technology using cryptographic algorithms to protect user biometric not stolen. The existing biometric encryption algorithm need external information input as part of the secret information, once the external leakage of information security of the whole system so that the system will be threatened, there are significant security risks. Only the facial features in our algorithm, does not need external information input, based on fuzzy information extraction, the intermediate R secret information H (R) (i.e. hash value) instead of the original w feature information storage in the database. As long as the hash function used is not reversible, collision free, even if the information in the database is also unable to recover the face adversaries from getting the information of the original. So that we can construct a security and privacy, can update the face authentication system. Therefore, the safety and convenience of the higher than the traditional password authentication. The key of this technology is the use of appropriate technology to ensure the safety of the biometric information and key. (Wittrahm, A., 2015).

2.2. Random Space Quantization

Random space quantization (RMQ) using a transformation reproducible facial feature mapping to random space, and in the key extraction after mapping space. The algorithm in addition to providing biological characteristics, also need a key mapping as a random seed, stored in the user token or input by the user can be the key. At the time of registration, use the key as a random seed to generate a set of pseudo random mapping matrix. Through the random mapping matrix N dimensional face feature mapping to P dimensional space ($P < N$). Finally, a threshold is used to discretize the face hash generating a binary value. In the test, using the same method to handle user samples, comparing the results with the original hash value between the Hamming distance. By changing the key can generate different templates. (Staab, P., 2015).

3. Fuzzy Random Cyclic Mapping Algorithm

Based encryption technology based on the study of existing biological characteristics, random mapping and FCS will use the RMQ keys and error correction technology, designed a face biometrics for face image encryption algorithm: fuzzy random cyclic mapping algorithm (Fuzzy Commitment Scheme, FCS). In each cycle, using a circular key as a random seed to generate a mapping matrix, the facial features of the user's map, the formation of a cyclic random mapping process. Fuzzy random cyclic mapping algorithm as shown in figure 1 (Hartsell-Gundy, J., Johnson, E. O., & Kromer, J., 2015).

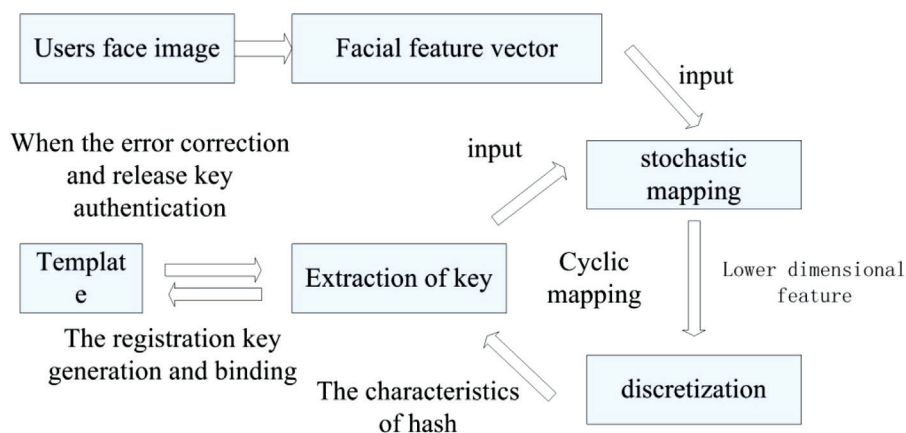


Figure 1 – Fuzzy Random Cyclic Mapping Algorithm

The FCRM process is divided into two parts: registration and certification. The registration process, the use of a circular key generated as a random seed random mapping, the face image feature of users through random mapping reduction and discretization, get a set of features of hash value. Then generates a random key and add error correcting codes the hash value bindings, and bind the results of each round of the cycle and key hash value as the template is stored in the server or user token. The authentication process is with the use of a cyclic process on the contrary, the features extracted from the template to release the hash key random mapping, if the key value preservation and eventually release the hash in the template are exactly the same, then through certification (Felizardo, V., Sousa, P., Oliveira, D., Alexandre, C., Garcia, N. C., & Garcia, N. M., 2014).

The core of FCRM is cyclic random mapping. It uses the avalanche effect in the process of cyclic random mapping to improve the security of the algorithm. The avalanche effect refers to the small change of plaintext or key will cause the ciphertext is completely different, it is a kind of encryption technology is often used in the algorithm. In this algorithm, if a different key extraction cycle, then in the next cycle, will have a great error characteristics of hash values. Through repeated cyclic mapping, can effectively prevent the illegal image is very close to the legitimate users face image feature through the authentication. (Maravic, M. U., Gracan, D., & Zadel, Z., 2015).

As a biometric encryption is an important indicator of safety, saving key and biological characteristics is a very key problem. If the facial feature template values stored in clear text server, once the server is invaded, the biological characteristics of the user is no longer available, but the biological features for users and can not be changed, so a replaceable, encrypted storage, is a key technology of biometric encryption technology security. Use the FCRM template mechanism can easily be biological features with a set of random key bindings, so as to ensure the safety of users of biological features. And if the authentication, user authentication hash value and feature registration difference is too large, will not be able to release the same key, so as to ensure the safety of the template.

In order to affect the recognition rate to prevent random noise users face image feature of the error correcting mechanism is introduced in the template, the user

registration and user authentication hash features vary in a certain range, can get the correct key.

3.1. Extraction of Biological Characteristics

The study, by using principal component analysis (PCA) feature extraction will produce large deformation in the random mapping, the recognition rate will have a relatively large decline. This phenomenon and the conclusion of Teoh, which may be due to a high dimensional descriptive projection feature extracted by PCA in causing random noise.

LBP is a kind of effective local texture operator in each block, the center pixel and neighborhood pixel sampling after comparing, after discretization, calculate the encoding value, in block histogram is established. Most face recognition algorithms by using uniform local two value model proposed by Ojala (Uniform PLA) operator. We found in the previous study, through the integration of multi rotation invariant uniform local two value model (Rotation Invariant Uniform LBP, RIU-LBP), at the same time dimension can ensure the recognition rate greatly reduced feature. Therefore, based on the RIU-LBP features as feature vectors of feature encryption algorithm.

3.2. Random Mapping

Random mapping is a very effective method of dimension reduction, the general formula can be expressed as:

$$v = \kappa R \omega \quad (1)$$

Random matrix $R \in R^{p \times m}$ ($m \leq p$), P and P respectively are before and after mapping the dimension of feature vectors, κ is constant. Johnson-Lindenstrauss (J-L) lemma proves that any data points in P dimensional Euclidean space can be mapped to within

$O\left(\frac{\ln(n)}{\varepsilon^2}\right)$ dimension space, and can guarantee the distance between them is maintained

in a very small range. (Oliveira, N., 2015).

Random mapping generated by mapping matrix, using the key as a random seed mapping, the improved formula is (Boullier, D., 2015).

$$s_n = \{k_0, \dots, k_{n-1}\} \quad (2)$$

$$v_n = R(s_0, m) \cdot \omega \quad (3)$$

In the formula, n represents the number of cycles, the symbol $\cdot$ represents the matrix multiplication, $v \in R^m$ is m dimensional feature vector dimension reduction by random mapping, and the size of m can be changed according to actual needs. k_i is the I random key cycles generated, and $0 \leq i \leq n-1$. When $i=0$, $k_0 = \lambda$ (λ is constant). $R_{nd}(x, m)$ is random matrix generating function, it uses X as a random seed, mapping to generate

a matrix of $p \times m$. Through the matrix, p dimensional face feature can be mapped to m dimension $p \times m$.

Formule (2) represents it would $n-1$ cycles have a key connection for a new vector, and as a seed to generate a random mapping matrix. The original feature mapping using the matrix, get the N cycles feature v_n .

3.3. Feature Discretization

Because the need for subsequent processing in the binary space, so it is necessary to feature vectors in Euclidean space converted to binary space. This V in formule (2) is progressing zero mean and discretization, and user's biometric hash value H was gotten. Zero mean method.

$$v = v - \bar{v} \quad (4)$$

Wherein , V represents a feature generation cycle, $\bar{v}$ said the average of all the dimensions v .

Discretization method for,

$$h_k = \begin{cases} 0 & v_k \geq 0 \\ 1 & v_k < 0 \end{cases} \quad (5)$$

Wherein , H is hash value generated by the feature mapping, h_k is the K dimensional data of H , v_k is the K dimensional data feature, and the $0 < k \leq m$ (M is the number of dimension V).

3.4. The Registration Process Template

At the time of registration, in the cyclic mapping every time the process will generate a random key, its role is as follows:

1. to use as a random seed mapping process next to the use of formule (2).
2. the security features of hash generated by this cycle of binding protection. The key is to bind with type (4) features in the hash h combination process.
3. with error correction code in the key, can affect the recognition rate to reduce the random noise in the user face image feature.

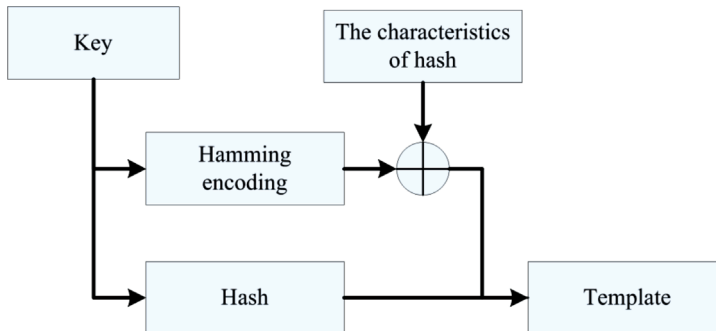


Figure 2 – Template Generation Process

Binding key and characteristics of hash results will be stored on the server as a template or token key and hash value, used in authentication key release. In front of the key bindings, need to add error correcting code. The N loop template generation formula can be expressed as T_n

$$c_n = \text{Encode}(k_n) \quad (6)$$

$$b_n = c_n \oplus h_n \quad (7)$$

$$T_n = (b_n, \text{Hash}(k_n)) \quad (8)$$

Wherein, $\text{Encode}(x)$ represents the error correcting encoding algorithm, this paper use Hamming code correction, c_n is encoding of k_n after the hamming. k_n and h_n , respectively, which indicated that the N cycles generated by random key and biometric hash values and symbols $\oplus$ that spatial binary bitwise XOR. $\text{Hash}(x)$ represents the hash function which can be used more common Sha (secure hash algorithm 1) or MD5 (message digest algorithm 5) algorithm.

3.5. The Release of in the Certification Process and Determine the Key

In the authentication stage, face image authentication user random mapping feature, hash value, and use the value of the release key from the template. Due to the influence of user expressions or background noise, this feature extraction and registration when the hash is not exactly the same. In order to ensure the recognition rate of legitimate users, the release process must reduce the influence of random noise on it. The release of the formula can be expressed as,

$$c'_n = b_n \oplus h'_n \quad (9)$$

$$k'_n = \text{Decode}(c'_n) \quad (10)$$

Wherein, c'_n represents a certification from the template release with error correcting code key, h'_n represents obtained certification process characteristics of hash value, k'_n represents the release of the key, $\text{Decode}(x)$ denotes Hamming decoding algorithm.

Release the key as well as the seeds of a random mapping, but also used to judge the legality of user authentication. If different keys and registration, the user is considered to be an illegal user authentication process termination. In order to protect the security of the key, plaintext does not save the template in the key, but holds the key hash value, to authenticate the key hash value through the judgment of authentication and registration. If the $\text{Hash}(k'_n) = \text{Hash}(k_n)$, you can consider the legitimate user, proceed to the next round of cyclic mapping. Otherwise, not through certification. Key release and determination as shown in figure 3.

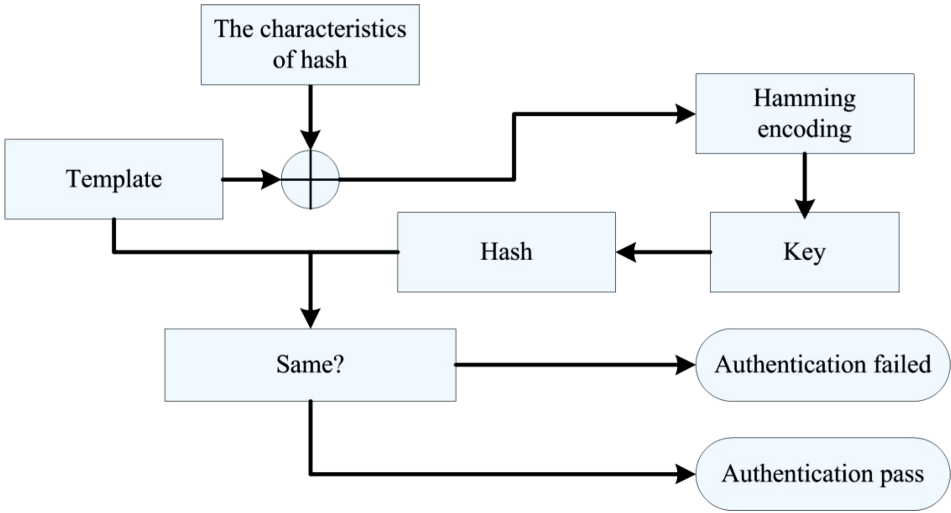


Figure 3 – Key Release and Determination

4. Experimental Analysis

This paper tested the FCRM algorithm in the Face Recognition Technology database. This experiment using face images for 1000 users (this is with 2 and above the frontal face image is the maximum number of users in the FERET Library), and from each user of the front face like randomly selected 2 different pictures respectively as image registration and certification process. These images after illumination correction and geometric registration standard resolution 160*140, then extract parameters for sampling density 16, with a radius of 2, sub blocks is 8*7 RIULBP. From the dimension of feature vectors for 800 dimension. This paper through the encryption algorithm, to generate a key length of 128 bits, because 128 is commonly used encryption algorithm authentication key length, the user can use the release keys for data encryption and decryption operation. The experimental results in the acceptance rate for registration and certification of 2 pictures of 1000 users each after the results of the test 1000 times. Authentication error rate of 2 pictures for each user and the other 999 users were tested the results of the test 2334631 times.

4.1. Discrete Random Mapping and Validation

The feature vector in figure 4 for RIULBP extraction after zero mean and discrete Hamming distance, the red line represents the Hamming distance between the legitimate users 2 different photographs, blue line indicates the Hamming distance between different user's pictures. From the figure can be found, between the legitimate users and the Hamming distance in general than illegal users and between the legitimate users and the difference of less, so RIULBP after discretization, still can distinguish the difference between the legitimate users and between users of illegal.

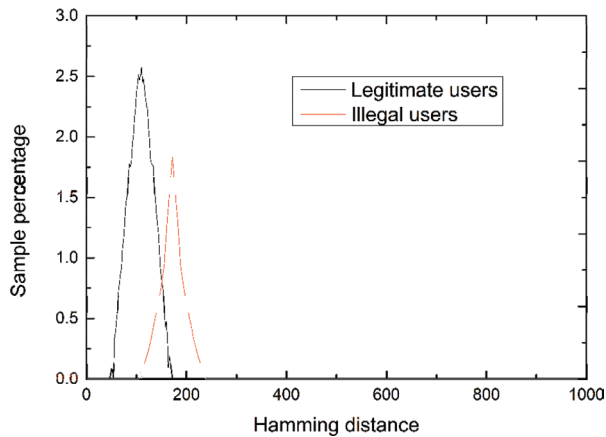


Figure 4 – The Original Feature Vector Hamming Distance

Figure 5 shows the comparison between the Hamming distance characteristics obtained by a random hash mapping feature value. Thus, the original features still remain unchanged in a mapping space, so that the random mapping is a dimensionality reduction means a good effect.

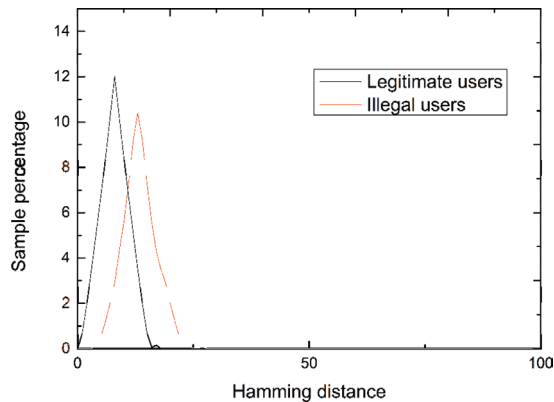


Figure 5 – Random Mapping After Hamming Distance

But it also can be found, although there is a certain distance between the legitimate users and illegal users, but still quite close, only a random mapping, they cannot be effectively separated.

4.2. The Performance Analysis of Fcrn

The experiment found that error correcting algorithm of error correction rate must be controlled in the most legitimate users can identify the degree, otherwise the recognition rate will be greatly affected. We can see from Figure 5, the legitimate user is approximately

the length of the hash curve in the range of 0-33%. So based on the key to support 33% interpolation, Hamming code error correction rate.

The cycles of the algorithm is also more direct impact. The more the number of random maps, the recognition rate will fall sharply. The cycle number is 3, the acceptance rate and the error rate can be controlled in a better degree. Figure 6 is the 3 cyclic mapping feature extraction and obtain the hash Hamming distance value. Fig. 5 Comparison of visible by cyclic random mapping, due to the formation of the avalanche effect, characteristics of hash value from illegal users is very close to the legitimate users of the original, into a normal distribution in $m/2$ (M key length) nearby, which can effectively distinguish between the legitimate users and illegal users.

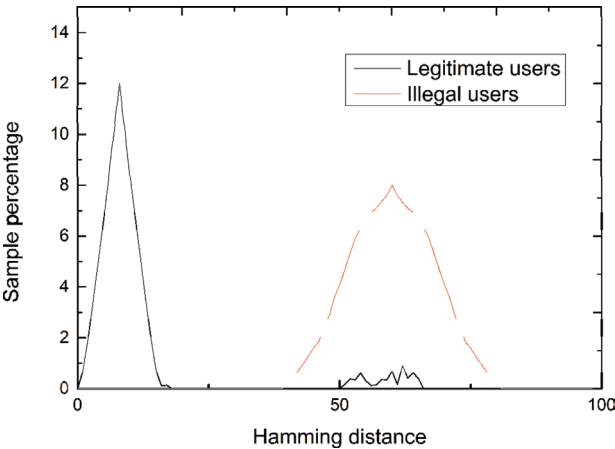


Figure 6 – 3 Cyclic Random Mapping After Hamming Distance

In addition, the length of the key for the safety and the recognition rate also plays a very important role. If the key is too short, the illegal users have the opportunity to get the same with the legitimate user key. On the contrary, if the key is too long, it will lead to decline of recognition rate. So to get a reasonable length of the key in the experiment, it is very important. Table 1 lists the different key length of 3 cycles when the legitimate user authentication failure false rejection rate (False Reject Rate, FRR) and illegal user certificate by the false acceptance rate (False Accept, Rate, FaR). Because of the random shot mapping of facial features is the result of randomness, so the actual FRR + 5% floating around, but the false accept rate because the sampling quantity is big, so the result is almost not affected.

The length of K1	The length of K2	FRR(%)	FAR(%)
6	6	4.24	0.0016
6	9	6.43	0.0019
9	9	7.53	0
9	12	9.46	0
9	12	17.64	0

Table 1 – The Length of Key Authentication Result

4.3. Analysis of FcrM Security

From the security of the encryption process, biometric authentication user generated in each cycle in the process of mapping the key must be the same, otherwise unable to restore and registered users the same key. Experimental results show that if different as a random seed key, then extraction of the hash value will show a random normal distribution in cardinality $m/2$ (M is the length of the key) in the vicinity.

In the process of authentication, key collision probability of different $\frac{1}{\text{len}(k_1 + \dots + k_{n-1})}$ (N cycle). When the length OF k_1 k_2 are 9, the collision probability is $\frac{1}{262352}$; when the length of k_1 k_2 are 12, the collision probability is $\frac{1}{17236952}$. Therefore, the attacker is difficult to try to crack the password through the exhaustive.

5. Conclusions

Facial features to its universality, intuitive and non invasion has been widely used, which combined with cryptographic techniques can overcome the traditional face recognition system of disclosure of privacy and other shortcomings, provide an important guarantee for the people's demand for information security. Based on the advantages and disadvantages of the existing algorithms, FCRM algorithm is proposed. Based on the face biometric cycle using random mapping to enhance safety authentication, impact into the error correcting codes in key against random noise, safety of biological characteristics and key and use the template mechanism to protect users. Through experiments, the face biometric fuzzy cycle random mapping encryption algorithm with high security based on. The proposed face biometric encryption algorithm for virus invasion has good resistant effect, has a good role in promoting the application of face biometric encryption algorithm.

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Application of UAV in the Field Management of Construction Project

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Abstract: UAV is an unmanned aerial vehicle operated by the radio remote control device or its own program control device. In recent years, the rapid development of geographic spatial information technology, especially the flexible and fast response ability of light and small aviation, is the rapid growth in recent years, and has become an attractive bright spot in the field of aviation remote sensing. (Objective) in order to study the application of unmanned aerial vehicles (UAV) in the construction field, this paper analyzes the feasibility and value advantage of unmanned aerial vehicle technology in the field of bridge engineering construction. (Analysis) the advantages of different types of UAVs are discussed in the present stage of bridge measurement. (Conclusion) with the development of unmanned aerial vehicle technology, and the development of its cost, the performance and functions, the paper analyzes the development of unmanned aerial vehicle in engineering construction.

Keywords: UAV; digital measurement; bridge engineering; construction engineering.

1. Introduction

1.1. UAV Status

From the early “automatic flying bomb” to the 1930s real significance on the first frame without man-machine British “queen bee” UAV, the modern UAV development from can recycling, can remotely-operated and autonomous flight towards highly integrated, multi mission platform, a lots of man-machine direction (Siebert S, TEIZER J., 2014).

American NASA set up a world class UAV application center, specifically designed for the commercial application of high resolution camera sensor. Israel to form the special civil without man-machine and working mode of the trial committee, given the heron UAV non-military tasks, the implementation of the certificate, and flight test of a variety of civilian missions in cooperation with the relevant departments. Europe in 2006 to develop and immediately various funds to implement the “civil UAV development roadmap”, after the European Union intends to set up a pan European Civil UAV coordinated organization, in order to solve the problem of the key air safety and

airworthiness help. At present foreign civil UAV has been in various industries actively spreading, online retail giant amazon.com is using unmanned aerial vehicle (UAV) for the express delivery service; drones to track down tropical storm related data for the National Oceanic and Atmospheric Administration, thereby improve the hurricane warning model; Yamaha UAV use equipped with infrared camera to monitor the crop growth; Canadian police equipped with FLIR camera police no human search for the missing persons. The beginning of the civil aircraft in China is not too late. (Gasca-Hurtado, G. P., Peña, A., Gómez-Álvarez, M. C., Plascencia-Osuna, Ó. A., & Calvo-Manzano, J. A., 2015) At the beginning of the 20th century, it will try to develop the unmanned aerial vehicle in map and geological exploration. In recent years, designed for civil developed the “GUI Zhou” unmanned aerial vehicle (UAV) to achieve a smooth first flew; can be autonomous takeoff and landing and hovering and route planning “bees” unmanned helicopter, application in agricultural spraying, power inspection, disaster prevention and emergency response, aerial mapping, communication relay etc.; “vertical tail”, “double” three types of series of UAV has been completed successfully in the west of our country 1:50000 map free zone 10 county area of digital aerial photography missions (NONAMI K., 2007).



Figure 1 – Unmanned Aerial Vehicle (UAV)

1.2. UAV in the Engineering Construction of the Advantages of Surveying and Mapping

With the continuous development of various new sensors and photogrammetry, the digital mapping technology based on UAV has overcome the problems such as high cost, low accuracy of aircraft attitude control, manual measurement of aircraft attitude control, and so on (Willmann J, Augugliaro F, Cadalbert T., 2012).

Application of UAV in the road construction includes the aerial photographs of various thematic content and aerial surveying and mapping, for the route selection and line of survey and design to provide information, combined with aerial film hydrological and geological interpretation, to match line scheme selection, to meet the road design at the beginning of the measured map. Therefore, based on the application of UAV mapping technology to road construction projects in the early stage of line selection and bridge crossing scheme, the late works of debris flow, collapse, landslide investigation can play a good role (Illescas, G., Sanchez-Segura, M. I., & Canziani, G. A., 2015).



Figure 2 – UAV Engineering Survey

1.3. The Function of the UAV to Bridge Engineering

Bridge structure is a kind of large civil engineering structures, due to the effect of load, fatigue and corrosion, material aging and lack of timely maintenance, the use of the inevitable damage accumulation, resistance decline, and even lead to sudden accident. To prevent the occurrence of accidents, it is necessary to detect, evaluate, identify, control and repair the structure and facilities used in the construction and facilities. Through bridge inspection, we can ensure the safety of bridges, and early detection of bridge disease and abnormal phenomenon, provide scientific basis for bridge maintenance and maintenance, and take reasonable maintenance and reinforcement method, prolong the service life, improve the bearing capacity, reduce maintenance cost, and remove the reconstruction (Yun M, Kim J, SEO D., 2012).

Bridge detection is mainly of inspection and assessment for the appearance and structure performance, usually check on the performance of the structure is tested by a series of mechanics, and the appearance inspection mainly rely on the naked eye or auxiliary tools (such as bridge inspection vehicle, telescope, et) to detect bridges main member whether cracks, breakage, exposed reinforcement corrosion, bearing cavity disease (Torres-Sánchez J, Peña J M, De Castro AI., 2014). For special structures such as cable-stayed bridge, suspension bridge, concrete filled steel tube arch bridge and so on, the traditional detection tools can't be used, but can only return to the original form of manual detection. As for the detection of the cable stayed bridge, artificial climb up the cable down to detect the operation, not only the efficiency is low, the difficulty, the risk coefficient is high, and the detection precision is far from enough, and the UAV has the characteristics of low cost, Yi Cao, with high flexibility, capable of carrying some important equipment from the air to complete special tasks, survival ability, good mobility, easy to use, safe and stable. So the application of UAV technology will solve this problem to a great extent.

2. Bridge Detection of UAV Technology Research

2.1. A Variety of Bridge Measurement

Now, conventional bridge security detection equipment is single, the main detection equipment with artificial telescope, a remote camera, bridge inspection vehicle, preset

orbit video detection. Artificial telescope and remote camera because of far distance target detection. It is found that the bridge disaster information more difficult (such as bridge cracks); bridge inspection vehicle for testing personnel transported to the bridge at the bottom of the implementation of artificial detection, has high cost, long detection time, affecting normal traffic, testing staff personal security risks and other issues (LI Y, ZHAO J, DING X., 2005). In addition, in use process, bridge inspection vehicle by light, the environment and other serious effects; preset orbit video detection required in the bridge to be examined regional pre laying track, long construction time, high cost, the orbit cannot be in the other bridge of repeated application of such problems.

Therefore, the existing bridge detection equipment has the problem of this or that, in the current bridge security detection needs of rapid growth, if you can use a simple and easy to operate, and the cost is low, the high security of the video detection equipment to detect the location of video detection, will be able to achieve a very effective bridge detection, and can be widely used. Due to the specific requirements of the stability and positioning of the four rotor aircraft, the control system of the aircraft control system is higher, so the design of the four rotor aircraft flight control system is proposed in this paper”.

Compared with the unmanned aircraft (UAV) structure is simple, light weight, small size, low cost, can complete a certain task that people can't perform the aircraft, such as reconnaissance and rescue mission, scientific data collection, geological, forestry exploration, agricultural pest control, as well as video surveillance, video production, etc.. Through the unmanned aerial vehicle to accomplish the above tasks can greatly reduce the cost and improve the security of personnel (NYGÅRDS J, SKOGLAR P, ULVKLO M., 2004).

Unmanned aerial vehicles can be divided into fixed wing UAV and rotor helicopter. Compared to fixed wing UAVs, helicopter rotor has a strong adaptability to environment, with automatic take-off and landing capability, attitude to the various flight (hover, fly front, side fly and inverted) advantages such as, these advantages determine the helicopter rotor than fixed wing UAV has a wider application prospect.

Rotor helicopter in the use of more, the technology is mature single wing and four rotor wing aircraft. Four compared with other aircraft, its advantage is that the mechanical structure is relatively simple, and can be achieved by changing the speed of the four motors, and the ability to fly more flexible (Walter B, SANNIER A, REINERS D., 2006). At the same time, the four rotor aircraft has a high control performance, and has the ability to take off, hover, flight, and landing in the area of the district. The aircraft can fly to the more near the target, but unlike the traditional helicopter because of its huge single wing and can't close to the target. At the same time, the four rotor aircraft also has the advantages of effective load bearing capacity, the reduction of the rotation effect, so the four rotor aircraft has a strong appeal to the researchers.

Compared with other flight principles, the VTOL (vertical landing) system has the feature of being very difficult or impossible to perform for other aircraft. Table 1 provides a non-thorough comparison between the different types of aircraft, which is analyzed from the viewpoint of miniaturization. From this table, we can easily get the conclusion that the VTOL system, such as a helicopter or an airship, has no doubt compared with other concepts. This advantage is due to their vertical, stable and low speed flight of these

unique capabilities. The key advantage of the airship is “automatic rise” and the simple control of the key is necessary. However, it has a unique configuration of the VTOL means of transport which represents the most promising concept of flying in the future (Gui D Z, Lin Z J, Zhang C C., 2012).

Flight performance(1=bad,3=good,2=kind)					
	Ordinary aircraft	Helicopter	Bird	Rotor aircraft	Airship
<i>Energy consumption</i>	2	1	1	2	3
<i>Control consumption</i>	2	1	1	2	3
<i>Carrying capacity</i>	3	2	2	2	1
<i>Operability.</i>	2	3	3	2	1
<i>Static flight performance</i>	1	3	2	1	3
<i>Low speed flight performance</i>	1	3	2	2	3
<i>Vertical lift performance</i>	1	3	2	1	3

Table 1 – Comparison of Flight Principle

The four rotor aircraft has the advantages of helicopter and fixed wing aircraft, and the aircraft has excellent flight control performance and adaptive capacity, so it is not only suitable for the implementation of scientific data collection in the near ground environment, but also provides a good platform for the monitoring, reconnaissance, rescue and assault transportation. Nuclear power plant explosion, resulting in a wide range of nuclear pollution, while the search and rescue and data collection work very unmanned aerial vehicles to complete, so not only greatly reduce the cost but also improve the safety of personnel, so it has a more broad military and civilian prospects (Yunhong M, Deyun Z., 2006).

At the same time, the study of the four rotor wing aircraft is also a platform for automatic control, advanced sensing technology and computer science, and many other fields. In intelligent control of robot, the three-dimensional path planning, the air traffic management and collision avoidance of multi aircraft, the small four rotor aircraft autonomous flight technology has high research value.

2.2. UAV Aerial Photography Features

Due to the limitation of the airborne remote sensing platform and the sensor, the ordinary aerial photogrammetry is the problem of obtaining the small area, the large scale data, the high cost and poor performance. It's low altitude UAV remote sensing image with low cost and flexibility and so on (METNI N, Hamel T., 2007). It is an important supplement to the national remote sensing monitoring system. It is the future development direction of aviation remote sensing. In the situation of the rapid development of satellite remote sensing and remote sensing, light and low altitude remote sensing is an indispensable and important technical means in the system of the fine resolution and fine resolution.

The first flight of the satellite, can be achieved by the high level of cloud cover, and can be achieved by the multi angle. That's low, relatively short training period for the operator.

Maintenance and repair of the system is simple, also do not lease off and parking space, without landing airport, and flexible, adaptable, easy to become a user self-owned equipment; fifth, avoiding the pilot safety risk; the sixth, than in the field, no aerial man-machine method has short period, high efficiency, low cost, etc.

For the large scale terrain survey tasks, it is limited by weather and airspace management, and high cost, and the use of the whole field data acquisition method, the amount of work is large, and the cost is high. And there will be no of UAV remote sensing system engineering and practical development, you can use it maneuver, rapid, economic and other advantages in cloudy, mist day can obtain qualified color image, which will be transferred to a large amount of field work in the industry, which can reduce the labor intensity, and to increase the technology level and accuracy of the operation.

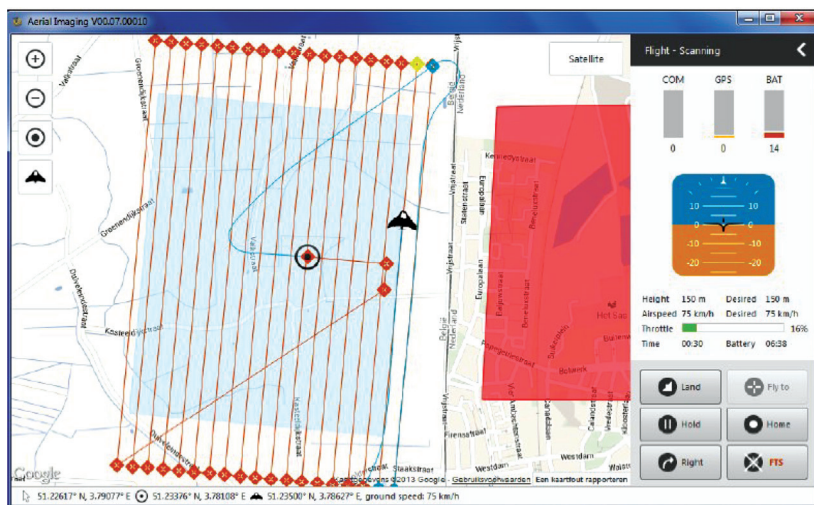


Figure 3 – Flight Operation and Control of UAV System

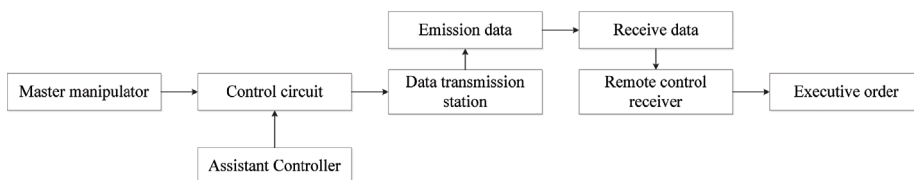


Figure 4 – UAV Operating System

3. Examples

Nanjing's bridge monitoring project, new monitoring equipment small unmanned aerial vehicle (UAV), and the bridge cracks in 0.1 mm can also be it pulled out (MIKAELIAN T, Rhodes D H, Nightingale D J., 2012).

The project is to use machine vision to carry out bridge monitoring. At present, the bridge monitoring and comparison of advanced means is the use of sensors, laser sensors, GPS dynamic monitoring, but there will be a large of energy consumption, high cost. The laser sensor as an example, at least a year to 2 million cost. And the project is to use machine vision to replace the sensor.

“Said to be simple, is to use the camera instead of the eyes, with a computer to replace the brain, through the high accuracy of the photos to collect data, automatic identification of cracks on the bridge, deformation, etc.” They design products, generally used for the film to the aerial aircraft, but the equipped with high precision camera. When the bridge is monitored, the small plane took off, fixed a few photos of the bridge, and the software will automatically give data. Such a small thing, the accuracy can be much higher? RUAN Bin told reporters that their monitoring equipment, the identification accuracy can reach sub millimeter level, that is, 0.1 mm of the gap, it will be detected. They have also been compared with the results of sensor monitoring, and the two data can be the basic coincidence (RAWAT K, Lawrence E., 2014).

“Nanjing Yangtze River Bridge is now testing, but also need to be completed, at least a team work for two or three days, and the identification of cracks are on the human eye, where the most wide of cracks, but also by estimation.” These workloads, the project of the small aircraft can be completed in two or three hours, from the results, it is much more accurate.

It is understood that the core of the venture project is a complex algorithm of the software, and it is surprising that the entrepreneur should not be software professionals. “At that time is a bridge to monitor the project, if the purchase of the sensor, the cost is too high, what then forced himself to do an alternative.” In order to this software, entrepreneurs uninterrupted self-programming for two or three years, the other members of the entrepreneurial team are also so. In the continuous modification, the software is becoming more and more accurate (Quaritsch M, Kruggl K, Wischounig-Struel D., 2010). Once to the accuracy of the software testing, developers on a whim with a Yao Ming with arms akimbo of body photos, count of Yao palm and finger length. “In fact is a problem of scale, but using software to judge more accurate.”

In the understanding of the business products, some companies have a brainstorming. “There is a medical plastic company to contact us, we hope that we can develop such products, small aircraft flying around the head, the width of the glasses, eyes, nose height, tilt angle and so on the head of the entire data will be able to come out.” In theory, it is completely possible to achieve again, cross-border is not impossible.

4. Conclusion

With the development of economy, no aerial man-machine system from the end of the last century began the introduction of China, first attracted the attention of the scientific research unit, with the increasing application of the past few years of aerial survey technology and influence results, people began to realize the technology is advanced and broad should prospect (Tang Y, Gao H, KURTHS J., 2012). Those with no aerial man-machine technology pioneer of the technology of Surveying and mapping the likened

technology of 15 years with GPS (Global Positioning Satellite) measurement technology as the epoch-making, think it like 15 years ago in the domestic GPS technology as will promote the development of Surveying and mapping industry greatly. The UAV aerial technology will bring profound changes to the work of Surveying and mapping.

The UAV technology continues to mature, civil UAV cost-effectiveness ratio will be gradually increased, bearing capacity is gradually increasing, and meet more features of the machine will be applied to every corner of the construction industry. Combining 3S system for precise positioning, the skyscraper of the future may be able to rely on UAV lifting prefabricated modules to build, this way will save more money, time and labor; at the construction site, the UAV in addition to examine headroom hoisting operation, construction progress, material preparation, etc., in the future may be able to rely on the intelligent decision system planning and building materials, transportation and construction route, promptly transported materials, reduce the disturbance of the public traffic, to ensure the construction progress.

UAV with mobile flexible landing approach, low altitude tracking of autonomous flight mode, with fast response data acquisition capabilities and application to engineering construction has an important role. We using unmanned aerial vehicles to carry the related equipment timely informed of the aerial remote sensing images and engineering data, to facilitate the timely construction of three-dimensional model, for the project to provide intuitive analysis and scientific decision-making methods.

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Application of Bayesian Multi Kernel Learning Algorithm Based on Support Vector Machine in Feedback Mechanism

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Abstract: Relevance feedback technology plays an important role in improving the performance of image retrieval. However, there are many problems in the process of image retrieval, such as feedback, feedback effect, and so on. Bias classification algorithm will be constrained by the small sample problem, and the support vector machine and Bias classification will be affected by the training sample asymmetry problem. A feedback algorithm based on the combination of Bayesian and SVM is explored. The algorithm through the multidimensional normal distribution of the Bias classification, the image library is compressed, so that SVM classification for the relevant image database after Bias compression. Experiments show that the feedback algorithm based on reducing the number of feedback, improve the accuracy of feedback. The combination of Bias and SVM feedback algorithm reduces the number of search feedback, improves the feedback effect, improves the efficiency of retrieval has a very important significance.

Keywords: Bayesian; SVM; image retrieval; feedback algorithm.

1. Introduction

In recent years, content-based image retrieval has become a hot research topic. The traditional image retrieval system automatically extracts image features, by comparing the similarity between the images, from the image database to return the similarity of the image. In this system, the biggest problem is that there is a "semantic gap" between the low level features of the computer and the user's understanding, which makes the retrieval result unsatisfactory. (Gasca-Hurtado, G. P., Peña, A., Gómez-Álvarez, M. C., Plascencia-Osuna, Ó. A., & Calvo-Manzano, J. A., 2015) So the relevance feedback technology is introduced into the field of content-based image retrieval. (Comfort, W. E., & Zana, Y., 2015; JIANG, D., & OMOTE, K., 2016; Bouarara, H. A., Hamou, R. M., & Amine, A., 2015).

The basic idea of relevance feedback method is to allow users to evaluate and mark the results in the process of retrieval. Find out the results in which the query image related, which are not related, then labeled by the user related information, as the training sample of feedback to the system of learning, guide search for the next round, so as to make the

retrieval results more in line with the user's needs. Relevance feedback has many kinds of algorithms, such as the method based on query vector transfer, the method based on weight adjustment, the method based on machine learning and so on (Wu, C., 2015).

Based on the results of image retrieval, relevance feedback is a process of interaction between users and systems, which improves the efficiency of feedback and reduces the number of interactions between users and systems (Chang, X., & Yang, D., 2015). Bayesian feedback algorithm will be subject to the small sample problem and the training sample asymmetry problem, how to overcome this problem is essential to improve the feedback effect. In view of the above problems, based on the traditional feedback algorithm based on the combination of Bias and SVM (S+B) feedback strategy (Abdelsalam, M. A., & Ahmed, D. A., 2015). The algorithm with Bayesian classifier of image library classification, image gathering, to remove the irrelevant images to achieve image compression, and then use SVM classifier to reduce the image library feedback, so as to narrow the search scope of the algorithm, reduce the number of feedback and feedback effects. The problem of small sample and training sample asymmetry is also helpful (Favaro, M., & Picci, G., 2015). First, although retrieval at the start of the Bayesian classifier training samples is limited, but with the increase of the number of feedback, marked by the user and the increase of sample size, sample training gradually accumulate, gradually increased the number of samples, the effect of Bayesian classifier will change for the better. Secondly, Bayesian classifier algorithm parameters is not fixed, it updates its parameters with the change of number of samples, so every time feedback using Bayesian classifier are different, thus constructed Bayesian classifier will more reasonable, the effect will be better. Finally, the feedback process of user annotation is the first k images, only the label image, remaining is not related to the image, rather than the image library all the unlabeled images as irrelevant images. So it is almost impossible the training sample asymmetry. (Johnson, M. D., Hsieh, W. W., Cannon, A. J., Davidson, A., & Bédard, F., 2016).

2. Bias Distribution Under the Condition of Multidimensional Normal Distribution

2.1. Bayesian Formula

Let $A_1, \dots, A_n$ for a complete event, $P(A_i) > 0, i = 1, 2, \dots, n$. For the B of any event, if $P(B) > 0$, that is:

$$P(A_k|B) = \frac{P(A_k)P(B|A_k)}{P(B)} = \frac{P(A_k)P(B|A_k)}{\sum_{i=1}^n P(A_i)P(B|A_i)}, (k = 1, 2, \dots, n) \quad (1)$$

Wherein, $P(A_k|B)$ is a posteriori probability, $P(B|A_k)$ is the class conditional probability, $P(A_k)$ is a priori probability, $P(B)$ is calculated by a priori probability and class conditional probability, the full probability of B is called the result. (Johnson, M. D., Hsieh, W. W., Cannon, A. J., Davidson, A., & Bédard, F., 2016).

2.2. Multidimensional Normal Distribution

Gauss distribution model is a general probability distribution model. This model is simple, and the reality of the world a lot of events and Gauss distribution has a great similarity. Assume that $x \in \mathbb{R}^n$ in the n -dimensional space vector satisfies Gauss distribution, the probability density function for x :

$$p(x) = \frac{1}{(2\pi)^{d/2} |\Sigma|^{1/2}} \exp\left(-\frac{1}{2}(x-\mu)^T \Sigma^{-1}(x-\mu)\right) \quad (2)$$

Wherein, $x = (x_1, x_2, \dots, x_d)^T$ is the D dimensional feature vector, $\mu = (\mu_1, \mu_2, \dots, \mu_d)^T$ is the D dimensional mean vector, Σ is the $d \times d$ dimensional covariance matrix, Σ^{-1} is the inverse matrix of Σ , $|\Sigma|$ is the determinant of Σ .

2.3. Bayesian Discriminant Principle Under the Condition of Multidimensional Normal Distribution

Bias's classification is based on Bias's theorem, and the posterior probability is estimated by training a large number of samples. Bias classifier divides the sample into a class of posterior probabilities, so the discriminant function of the class ω_i can be defined as (Sharma, R. K., Chopra, S., Vernengo, L., Trincherro, E., & Sylwan, C., 2015):

$$g_i(x) = p(\omega_i | x), i = 1, 2, \dots, c \quad (3)$$

Because in the same pattern recognition problem, for different classes, the whole probability of the Bias formula is the same, so all kinds of discriminant function can also be defined as:

$$g_i(x) = p(x | \omega_i) p(\omega_i), i = 1, 2, \dots, c \quad (4)$$

In the discriminant function, the prior probability $p(\omega_i)$ is a constant that is independent of the feature vector, and the class conditional probability density $p(x | \omega_i)$ satisfies a certain probability distribution, assuming that the $p(x | \omega_i)$ is consistent with the normal distribution of the D dimension. The discriminant function is:

$$g_i(x) = \frac{p(\omega_i)}{(2\pi)^{d/2} |\Sigma|^{1/2}} \exp\left(-\frac{1}{2}(x-\mu_i)^T \Sigma_i^{-1}(x-\mu_i)\right) \quad (5)$$

The function contains index, which is not convenient to calculate. Taking into account the logarithmic function is a monotonically increasing function, it takes the logarithm, and gets rid of the irrelevant items:

$$g_i(x) = \ln p(\omega_i) - \frac{1}{2}(x-\mu_i)^T \Sigma_i^{-1}(x-\mu_i) - \frac{1}{2} \ln |\Sigma_i| \quad (6)$$

After the discriminant function, there is a basis for classification and discrimination. We can classify the data by comparing the size of the two kinds of discriminant function.

2.4. Implementation of Bayesian Algorithm

Because Bias classifier is vulnerable to small sample problem, in order to overcome the small sample problem, it is necessary to accumulate the results of each user. With the increase of the number of feedback, the training samples will be gradually increased, so that the training of the Bias classifier will be more accurate, and the feedback effect will be improved. (Zhou, F., Dong, Y., Wu, J., Zheng, J., & Zhao, Y., 2015).

According to the user annotation of positive and negative samples were trained each class of Bayesian classifier, to compare image database of every piece of images corresponding to the feature vectors are substituted into the two Bayesian classifier, the image library belongs to the class of positive images saved, back to the positive class image similarity of the first k images. (Graves, T., Gramacy, R. B., Franzke, C. L. E., & Watkins, N. W., 2015).

The specific process of relevance feedback based on Bayesian is as follows:

Step 1: according to the needs of users, select the results of the retrieval of the former K image annotation. Click on the current related to the image I_1^+ , the rest of the image I_1^- is not related, respectively, to update the relevant image class I^+ and not related to the image class I^- . Related image class: $I^+ = (I^+ \cup I_1^+) - I^-$; Uncorrelated image class: $I^- = (I^- \cup I_1^-) - I^+$.

Step 2: according to the update of the relevant image class I^+ and the uncorrelated image class of I^- , the use of formula to update the relevant image class and not related to the image class Bias classifier parameters.

Step 3: after each update parameters, image and not related to the image class will have a respective classification discriminant functions $g_r(x)$, $g_n(x)$, the image database image substitution two discriminant functions were determined. If $g_r(x) > g_n(x)$, the X attributable to the relevant image library.

Step 4: in accordance with the size of the image database to sort the image, after the former K image feedback to the user.

Step 5: save the search results, if the user is satisfied, the feedback process can be stopped. Otherwise, the user will then submit the image, go to the first step, and then feedback again, until the feedback results to meet the needs of users.

3. Support Vector Machines

3.1. Support Vector Machine Theory

Support vector machine is a machine learning method based on statistical learning theory, which is based on the theory of VC dimension and structural risk minimization. To find the best compromise between the complexity of the model and the learning ability

according to the limited sample information, so as to obtain a better generalization ability. (Wu, N., Yuan, W., Wang, H., & Kuang, J., 2016).

As a kind of training machine learning method, the training data is assumed as $\{(x_1, y_1), (x_2, y_2), \dots, (x_l, y_l)\}, x \in R^n, y \in \{-1, 1\}$. wherein, y is a class label.

Assuming that the linear discriminant function in n dimensional space is $g(x) = \omega x + b$, the corresponding classification hyper plane is $\omega x + b = 0$. After normalization of $g(x)$, so that the two class of sample x to meet the $|g(x)| \geq 1$, through its classification interval $2/\|\omega\|$. The classification interval is the largest equivalent to $\|\omega\|$ or $\|\omega\|^2$ minimum, so the problem of finding the optimal hyper plane is transformed into the two planning problem of the following objective function:

$$\min \phi(\omega) = \frac{\|\omega\|^2}{2} \quad (7)$$

Formule (7) the limiting condition are $y_i[(\omega, x_i) + b] \geq 1, i = 1, 2, \dots, l$. By introducing Lagrange multiplier $\alpha = (\alpha_1, \alpha_2, \dots, \alpha_l)$ to solve the two planning problem, the optimal solution of α_i^* , which is located in the classification of $\omega = \sum \alpha_i^* y_i x_i$. The sample x_i is located on the surface of the sample, which called support vector. (Mota, L. F. M., Alcântara, D. C., Abreu, L. R. A., Costa, L. S., Pires, A. V., Bonafé, C. M., ... & Pinheiro, S. R. F., 2015).

The final discriminant function is obtained:

$$f(x) = \text{sign} \left\{ \sum_{i=1}^l \alpha_i^* y_i (x_i, x) + b^* \right\} \quad (8)$$

For the linear non separable case, the SVM is introduced to relax the variable ξ and the penalty factor C , the objective function becomes:

$$\min \phi(\omega, \xi) = \frac{\|\omega\|^2}{2} + C \left(\sum_{i=1}^l \xi_i \right) \quad (9)$$

Through the nonlinear transformation of kernel function SVM, $K(x, y) = (\phi(x), \phi(y))$ converts the input space to high dimension space, and the optimal classification surface is obtained in the high dimension space, and the classification function of the high dimension space is obtained:

$$f(x) = \text{sign} \left\{ \sum_{i=1}^l \alpha_i^* y_i K(x_i, x) + b^* \right\} \quad (10)$$

Therefore, SVM can be well applied to nonlinear classification by selecting the appropriate kernel function K . (Gehrmann, R. A., Schwalenberg, K., Riedel, M., Spence, G. D., Spieß, V., & Dosso, S. E., 2016).

3.2. Support Vector Machine Algorithm

Although support vector machine under the condition of small sample can reach the ideal classification results, but in the feedback process marked by the user and the number of images, after all, is limited, so in order to solve this problem, cumulative each feedback user annotation of positive and negative samples. Therefore, with the increase in the number of feedback, labeled positive and negative samples will be increased, the cumulative training samples will be more and more, SVM feedback effect is bound to become better.

Based on the SVM algorithm process, with the majority of the feedback algorithm is similar to the process. First, the user of retrieval results are marked and, secondly, the user annotation results as training samples, the SVM training, generate the feedback the SVM classification model. Finally, the trained SVM classification model of image library for processing, feedback the user. After more than a few steps of the process, a relevant feedback has been completed, if the user is not satisfied with the feedback results can be transferred to the first step to continue to feedback, until satisfied.

The feedback algorithm based on SVM is as follows.

Step 1: according to the needs of users, select the results of the retrieval of the former K image annotation. Click on the image of the previous K image I_1^+ , the rest of the image is not related to I_1^- , respectively, with the results of the last marked cumulative. Update related image class I^+ and unrelated image class I^- . Related image categories: $I^+ = (I^+ \cup I_1^+) - I^-$; not related to the image class: $I^- = (I^- \cup I_1^-) - I^+$.

Step 2: according to the update of the relevant image set I^+ and irrelevant image set I^- training SVM, you can get the next feedback to use the SVM classifier.

Step 3: using second steps to get the SVM classifier for image database. In the image database, each image corresponds to the corresponding score $score(I_i) = f(x_i)$. The greater the score, the greater the degree of similarity with the query keywords. According to the size of the size of the image library to sort, the maximum score of the former K image feedback to the user.

Step 4: save the search results, if the user is satisfied, the feedback process can be stopped. Otherwise, the user will then submit the image, go to the first step, and then feedback again, until the feedback results to meet the needs of users.

4. The Relevance Feedback Algorithm Based on Bias and Svm

4.1. Bias Classification Under the Condition of Multidimensional Normal Distribution

Bias classification can be easily realized according to the Bias distribution under the condition of multidimensional normal distribution. The discriminant function formula (6) of Bias distribution under the condition of multidimensional normal distribution, the discriminant function of the class I has 3 parameters: the mean u_i , the covariance matrix Σ_i and the prior probability $p(\omega_i)$. In the process of relevance feedback, the user is assumed to label the related image and the image is not related to the two class.

Each feedback, according to the label of the two image categories, respectively, update the two categories of the Bias classifier parameters, you can continue to improve the performance of the two class classifier. The following 3 parameter updating equations for two Bias classifier:

$$\begin{aligned}
 P_r &= \frac{N_r}{N_r + N_n}, \quad P_n = \frac{N_n}{N_r + N_n} \\
 u_r &= \text{mean}(I^+), \quad u_n = \text{mean}(I^-) \\
 \Sigma_r &= \text{cov}(I^+), \quad \Sigma_n = \text{cov}(I^-)
 \end{aligned} \tag{11}$$

Wherein, P_r and P_n are related image class and not related to image a priori probability, N_r and N_n are the number of tagging related image and unrelated image, u_r and u_n are two classes of mean. I^+ and I^- represent image correlation and not related to image respectively, Σ_r and Σ_n are two classes of the covariance matrix.

After updating the parameters of the two classes by the formula (11), we can classify the image database. By classification, the image database is related to the image of the class to save up, constitute the relevant image library, the image does not belong to the relevant image library excluded.

4.2. Classification Based on Svm

SVM classification based on support vector machine theory. By nonlinear support vector machine classification function formula (9), the image x to the classification of hyper plane distance need to know the kernel function $K(x_i, x)$, Lagrange multiplier α_i and migration factor b^* . Kernel function selection of radial basis kernel function, Lagrange multiplier and offset factor can be obtained by solving the objective function $\phi(\omega) = \|\omega\|^2 / 2$ two programming problems, so that there is a nonlinear condition of the SVM classification function.

Classification is based on the SVM is related to the image library processing, classification of users want the image. Each feedback process, the user should be marked on the last retrieval results, marking the results with the last marked the results of accumulation. This training sample will update the change. According to the results of each feedback update training SVM, get the SVM nonlinear classifier. Finally, the SVM classifier is used to classify the relevant image database, and the final results are returned in accordance with the size of the similarity of the classifier.

4.3. The Combination of Bayesian and Svm Feedback Technology

Based on the above two classification algorithms, a new feedback algorithm combining Bayesian and SVM is proposed. First of all, the results of each feedback tagging are combined with the annotation results of the previous several times. Secondly, the use of the normal distribution of the Bayesian to establish the relevant image class and not related to the classification of the class of the classifier, while the results are used to train

the SVM classifier SVM. Finally, the image database is classified by two Bias classifier, and the image collection, which is related to the image database, is obtained. And then use the SVM classifier to classify the relevant image database, and return the final results. The flow chart is shown in Figure 1. The specific algorithm flow is as follows:

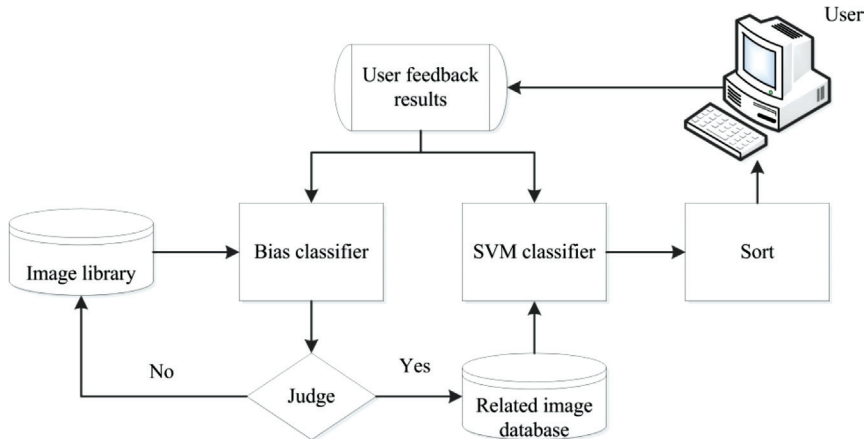


Figure 1 – Feedback Flow Chart

Step 1: according to the needs of users, select the former K image as retrieval results to return to the user. Users of the K images are marked, click on the current relevant image I_1^+ , the rest of the image I_1^- is not related to, respectively, to update the relevant image class I^+ and the unrelevant image class I^- . Related image categories: $I^+ = (I^+ \cup I_1^+) - I^-$, unrelevant image class: $I^- = (I^- \cup I_1^-) - I^+$.

Step 2: according to the update of the relevant image class I^+ and unrelevant image class I^- use formula (10), respectively, to update the relevant image class and not related to the image of the Bias classifier parameters, while training SVM, get the SVM classifier.

Step 3: after each update parameters, related to the image class and not related to the image class has a separate discriminant function $g_r(x)$, $g_n(x)$. Put the image into the image database of two discriminant function to determine if the $g_r(x) > g_n(x)$. The X belongs to the image library. In this way, after the Bayesian discriminant, we get the feedback of the relevant image library U^+ .

Step 4: using the second SVM classifier to get the feedback from the image in the image database U^+ . In the relevant image database, each image I_i corresponds to the corresponding score $score(I_i) = f(x_i)$. The larger the score, the greater the similarity with the query image. According to the size of the size of sorting, the maximum score of the former K image feedback to the user.

Step 4: to save the retrieval result, if the user is satisfied, the feedback process can be stopped. Otherwise, the user will then submit the image, go to the first step, and then feedback again, until the feedback results to meet the needs of users.

5. Experimental Analysis

Select 30 semantic classes from the Corel image database, each class of 30 images, a total of 900 images, including birds, waves, monkeys, etc. Experimental SVM based on Libsvm, using the radial basis kernel function $K(x,y) = \exp(-\lambda \|x-y\|^2)$, $\lambda > 0$. Among them, the penalty coefficient $C = 100$ in SVM algorithm, parameter C and λ are the optimal values after several tests.

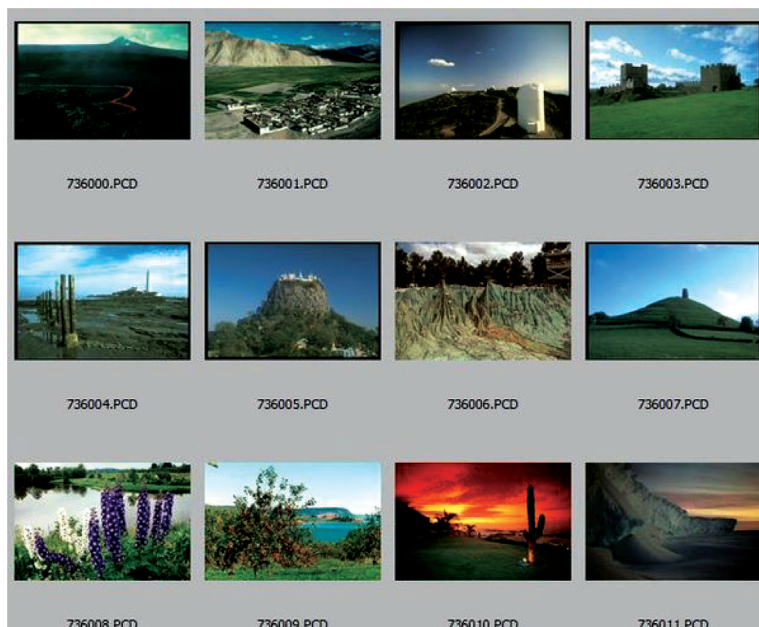


Figure 2 – System Interface

Assume each semantic class of images is a user query, taking into account the user's patience and greedy, assumes that the number of feedback for 3 times, each time a user feedback identification number of images for the interface in the first five pages of. 45 images. The use of general image retrieval performance evaluation criteria, namely the average precision evaluation system. The selected bird, mountain, monkey, bonsai, wave, flower and bear as their corresponding search keywords, were then analyzed each of the seven keywords feedback process before 27 pieces of image and the former 36 pieces of image image a number. Each of the key words of the first 27 images and the first 36 images of the feedback accuracy, and finally obtained through the 3 feedback after the average feedback accuracy. Feedback accuracy formula definition. A is for the previous K images in the number of related images, b is for the first K image of the number of images.

Figure 3 and Figure 4 are the 7 key words in the experiment selected the top 27 images and 36 images of the average precision. Based on the combination of Bias and SVM, the proposed method is compared with that of the conventional SVM or Bias feedback

algorithm. The average feedback precision of each feedback after 1 to 3 feedback is calculated respectively, and the results are compared with the results shown in Figure 3.

Figure 3 and Figure 4 shows the average recall and Top36 Top27. From the curve in the figure can be seen, along with SVM algorithm average feedback accuracy than Bayesian algorithm for good. By combining SVM and Bayesian algorithm to be better than the single use of the effect of two kinds of algorithm; combination of SVM and Bayesian algorithm in the three feedback has reached a relatively high feedback accuracy, used alone two algorithms when feedback accuracy.

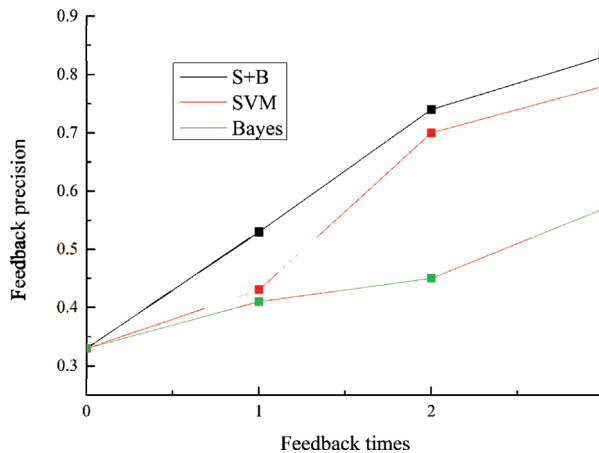


Figure 3 – The Average Recall Rate of Top27

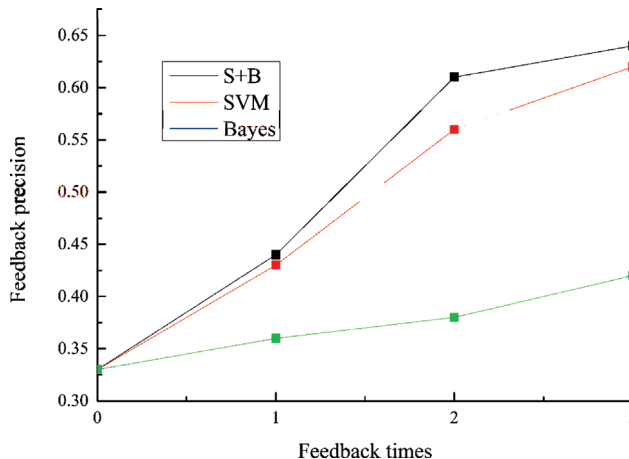


Figure 4 – The Average Recall Rate of Top36

In order to further illustrate the effectiveness of the Bayesian SVM algorithm, this algorithm is compared with SVM SVM (S+A) based on dynamic learning, and the results are tested on the same data set. Figure 5 and Figure 6 are the two algorithms in the top 27 and 36 average recall in the image comparison results.

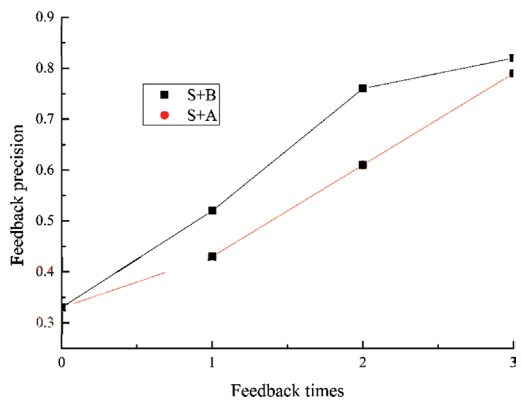


Figure 5 – The Average Recall Rate of Top27

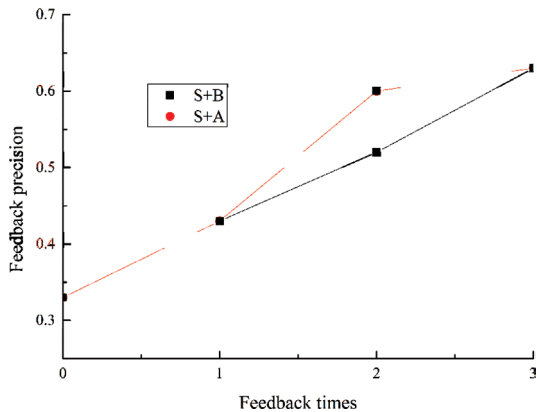


Figure 6 – The Average Recall Rate of Top36

Figure 5 and Figure 6 shows the S +B and S +A by 3 times the average recall rate feedback. Seen through the curve in the figure, both in 27 pieces of image or the first 36 pieces of image, combining Bayes and SVM feedback algorithm of average feedback accuracy in feedback algorithm based on dynamic learning of SVM, further proof that the effectiveness of the algorithm.

From the above experimental results, we can see that the combination of Bias and SVM feedback method. First use Bias to classify the image database, remove a lot of irrelevant images, but also related to the image of the relevant image library. This allows the SVM to be used for feedback, only for the relevant image library, rather than the entire image library, greatly reducing the search range, reducing the number of feedback, improve the efficiency and effectiveness of feedback.

6. Conclusions

In recent years, with the rapid development of network technology and multimedia technology, the number of images in the world is at an immeasurable speed. Tens of thousands of images have been brought to the real world by a considerable annoyance, because these images scattered in every corner of the world, the image contains useful information can not be effectively acquired. Therefore, relevance feedback is of great significance in the content based image retrieval. It is necessary to solve the problem of reducing the number of interactions and improving the accuracy of the feedback. This paper explores a kind of feedback algorithm combining Bayesian and SVM. The algorithm through the multidimensional normal distribution of the Bias classification, the image library is compressed, so that SVM classification for the relevant image database after Bias compression. Experiments show that the feedback algorithm based on reducing the number of feedback, improve the accuracy of feedback. In this paper, a feedback algorithm based on Bias and SVM is proposed to reduce the number of feedback and improve the effect of feedback, which is of great significance to improve the retrieval efficiency.

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Agricultural Economic Input-output Analysis Research Based on Computer Information Technology

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Abstract: Objective: with the development of agricultural soft science, in agricultural systems analysis techniques and methods, it using mathematical methods and computer processing relevant information and data to quantify. Methods: in this paper, we introduce between two groups of variables in multivariate statistical methods of canonical correlation analysis, stepwise regression analysis, factor regression analysis, principal component regression analysis and other statistical methods, the establishment of agricultural input output model.: the multi linear regression model of representation of the analysis method, least squares to evaluate and regression model test three methods to carry out agricultural economic input-output analysis research. Analysis: this collection twenty years since the agricultural input and output two groups of data, intended to through statistical analysis method to reveal our country agricultural input and output between the inner links. Conclusion: according to the database based on input-output table, the realization of the database automation system to achieve quantitative analysis of the efficient use of agriculture is possible.

Keywords: Computer information technology; Agricultural economic; Multi linear regression model; Database.

1. Introduction

Our country is a traditional agricultural country, rural population accounts for about two-thirds of the population, the farmers' income growth; regional income gap between urban and rural areas, agriculture, rural areas and farmer's problems in the process of China's modernization has become the most confusing one of serious problems (Sarmiento-Aguilar A., 2015). Central also pay attention to the problems of "agriculture, rural areas and farmers", the social from all walks of life around the problem of "agriculture, rural areas and farmers" is a vigorous debate, and a slightly effective solutions are put forward based on the analysis of the present situation of our country agriculture science. Many in academies are also committed to continuously research and explore. As shown in figure 1 of 2004-2012 per capita net income of rural and urban per capita net income of contrast figure (Zhu B Q., Wang Y L., 2016). Canonical correlation analysis, this paper discusses the

agricultural output level, the relationship between the agricultural labor productivity and its influence factors, the more realistic conclusion, this method can be for the contact between variables close degree, but you can't give the influence degree of the variables between the concrete and to understand the impact of one variable to another variable specific strength, start off with the regression analysis (Kessiba A M., Hegazy M A M., Abdelkawy M M., et al., 2015). It is from this perspective, this article first set of 6 to the output of the observed variables and input group six did a canonical correlation analysis, get three pairs of canonical correlation variable, and find out the variable plays the leading role in the canonical correlation variable, on the whole of the relationship between the variables of input and output group, after using the stepwise regression analysis, factor regression analysis, principal component regression analysis of multiple statistical analysis method, studied the present situation of our agricultural input and output, and the statistical model founded by the comprehensive comparison, finally it is concluded that the best regression model (Zhang W., Sun J., Cao Y., et al., 2015).

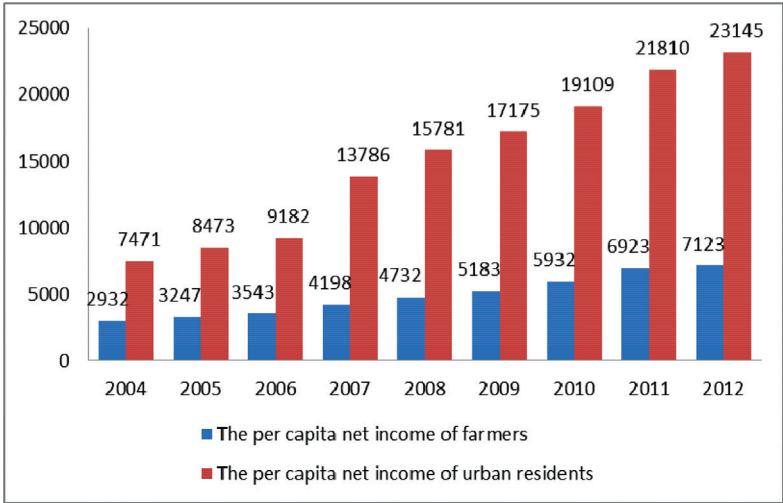


Figure 1 – Per Capita Net Income of Rural and Urban Contrast Figure in 2004-2012

Input-output model classification standard can be according to the analysis, the measuring unit, data range, properties, research purpose targeted measures to establish input-output table, such as the macro national economic input-output tables (He G, Yang S., Chen Y., et al., 2015); Professional different crop fertilizer rate, regional input-output table and so on. In the form of a database is realized in the computer table, in the form of a dictionary of Chinese characters library implementation code conversion, with random search report output, for Chinese characters of the new database, user-friendly, easy to learn, but also realize the function of database maintenance, lay the foundation for the analysis and operable (Posner S., Verutes G., Koh I., et al., 2016).



Figure 2 – Investigation of Input and Output

2. Method Principles

Regression analysis is the relationship between the studies of two or more variables statistical analysis method to reveal the internal relations between variables by determining the strength of a variable impact on another variable (Ioannis A., Dimitrios I., 2015). Various methods of mathematical statistics to regression analysis is applied to the most extensive, early in the 19th century regression analysis in the face of the least square method appears and in matrix algebra as the main mathematical tools, in the actual began application 100 years to its theory and methods has become increasingly rich and colorful, application of more and more widely, and the idea of regression analysis has penetrated into mathematical statistics other branch among, such as time series analysis, principal component analysis, discriminate analysis and so on .In this paper, a preliminary study on the conditions of agricultural development is an example (Verma D., Sankhyan V., Katoch S., et al., 2015).

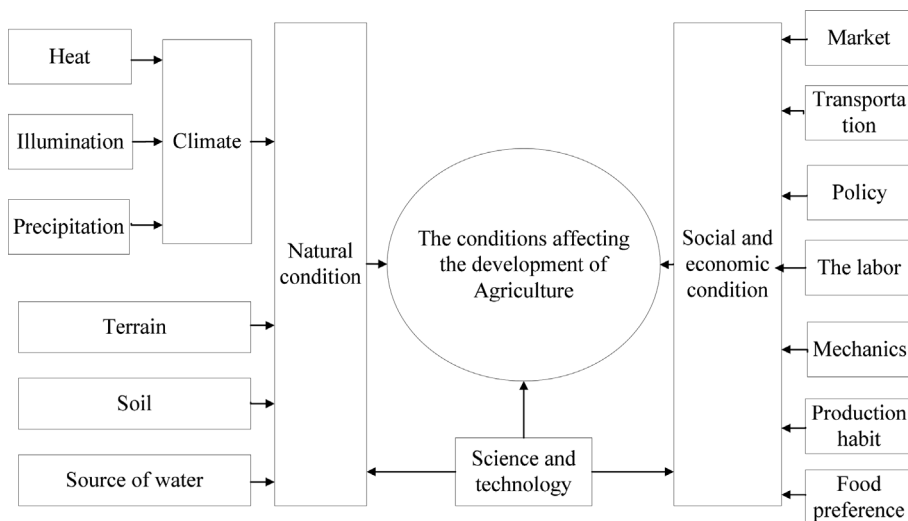


Figure 3 – The Conditions Affecting the Development of Agriculture

The most widely used, the theory has also been mature in multivariate linear regression, regression analysis, nonlinear regression problems many can also change into linear regression or using piecewise regression and polynomial regression to achieve. But multiple regression problems in the economic field, the universal existence of multiple regressions between variables, important the factors which are affecting the stable regression models, the regression model of income during the economic phenomenon does not conform to the principle. This article is trying to establish the multiple regression model between the output variables of investment in agriculture in China, also appeared in such a situation, using principal component regression analysis to eliminate the multiple regression, the establishment of principal components regression model. Such as figure 3 (Runa, A. I. D. N. F., & Miranda, G. L., 2015).

2.1. Multiple Regression Analysis Between Input and Output Variables

Input output variables First, as the dependent variables and input variables in y1 group x1, x2,..., x6 regression analysis model as an example, using SPSS statistical software, using stepwise regression analysis method to select variables, the final 4 variables into the regression analysis model, respectively: x_1 , x_2 , x_3 , x_5 from variance analysis multiple linear regression equation as can be seen in Table 1 when the significant level $\alpha = 0.01$, check the F distribution table was the critical value of $F_{0.01}(4, 18) = 458$, $F = 593.432 < 0.01 > 4.58$ or $P = 0.000$, so the regression equation is very significant, negative regression coefficients are zero assumption, can be considered as input variables of x1 group x2,x3,x5 and y1between dependent variables was statistically significant. The goodness of fit as can be seen in Table 2 when there are 4 variables into the model adjusted multiple coefficient of determination is 0.991, the fitting degree is very high, show that the fitting effect is very good But it can be seen from table 3 x_1 , x_2 , estimation of regression coefficient is negative, and the dependent variable was negatively correlated, which is inconsistent with the actual situation, may be due to variable between the variables. The results of expansion coefficient test using the variance can be seen, x_2 , x_3 , x_5 VIF values were larger than between 10 variable is the relationship between.4 variables in the average value of VIF is more than 1, so the regression model of serious variable, further generality diagnosis results are shown in Table 4, using the features test method, the third dimension for the condition number of 30.355, fourth, fifth in a row dimension the condition number is greater than 30 of these index data show that generality relationship is serious (Krott D., Hilgers C., BÜcker C., 2015).

Source of variance	Sum of squares	Freedom	Mean square	The value of f	The value of p
Regression	8626716	4	2156679.054	593.432	0.000
Residual	6541648	18	3634249		
The sum	8692133	22			

Table 1 – Variance Analysis of Multiple Linear Regression Equation

Model	Correlation coefficient	Multiple decision coefficient	Revision of multiple decision coefficients	Predictive value standard error
1	0.567a	0.321	0.289	530.23123
2	0.966b	0.934	0.927	169.1231
3	0.994c	0.987	0.985	76.32321
4	0.996d	0.992	0.991	60.321321

Table 2 – Goodness of Fit Test Table

Variable	Regression coefficient	Standard error	Standard regression coefficient	The value of T	The value of P	Tolerance	VIF
<i>Constant</i>	2496.163	538.178		4.53	0.000	0.154	5.432
X_1	-26.213	5.876	-0.221	-4.543	0.000	0.324	38.234
X_2	-2.123	0.394	-4.123	-3.234	0.004	0.234	84.342
X_3	2.153	0.876	0.932	4.232	0.000	0.342	24.234
X_5	3.225	0.964	0.632	3.557	0.002	0.234	52.234

Table 3 – Multivariate Linear Regression Parameter Estimation and Its Co Linear Statistics

From the obtained regression equation can clearly see that, because of the degree of correlation between variables and independent variables, and variables of multiplicity exist. The fitting degree reached a very high level. The regression value compared with the true value, we can see that the fitting effect is very good. From the regression equation we can see that our animal husbandry and fishery output value, the number of agricultural labor productivity and labor force is largely negatively correlated with the amount of chemical fertilizer agricultural mechanization level, significant positive correlation, shows that a large number of rural surplus labor has become an important factor restricting the development of agriculture in our country, but continue to invest in modern machinery greatly enhance the productivity at present, China's agriculture is still belongs to the high consumption and low efficiency of agricultural irrigation water, effective utilization rate of only 30%-40% (developed countries has reached 50%-70%), fertilizer when the utilization rate of only 30% (Liang X., Wang J., Bai W., et al., 2015). Therefore, the development of water conservation, and section fertilizer of precision agriculture is an important direction in the future of China's agricultural development. Especially in the agriculture of our country faces under the dual crisis of the water resources shortage and waste of water, water-saving agriculture industrial structure development, establish water-saving rural economic system. Government fiscal investment effect on agriculture is miniscule; efficiency in the use of funds is not high. Should be adjusted in a timely manner, in order to adapt to the development trend of China's agricultural modernization in the new century, namely, the transformation of traditional agriculture become market-oriented, knowledge, ecological, set the

modern agricultural intensification and socialization (Asiedu L., Oduro F., Adebajji A O., et al., 2016).

3. Processes

3.1. Input-Output Method

The input-output analysis was first founded by American economist Leontief, is a study in 1930s. He used this analysis method of the preparation of the 1919, 1929, 1939, the United States economic input-output table, is highly regarded by the United States government and economic circles. , world widely used this technology, mainly use economic mathematics method to study the entire national economy, regions, departments and enterprises in the process of reproduction in balance, preparation of the optimal plan, project construction or project, the reasonable organization and the overall arrangement, comprehensive detection of regional economy in the future period development and departments, enterprises of all kinds of products demand, production economic is currently the most widely used economic forecasting method is one of the. Input output analysis (YOĞURTÇU G., 2015), investment is refers to inputs in the production process of the object of labor, labor and live labor quantity; output is referring to the use of direction, quantity and distribution of products. Input output analysis first the preparation of input and output of the departments into a chessboard type input-output table, use economics principle, based on the balance between the input-output table of establishment of input output mathematical model. Then we use this model and matrix computation and computer algorithms, to analyze and study the dependent relationship between the production and consumption of products. We apply input-output analysis, both to carry on comprehensive balance, and to predict the future, but also the problem of economic structure, economic benefit and commodity prices for comprehensive analysis. As shown in figure 4 Input-output ratio charts

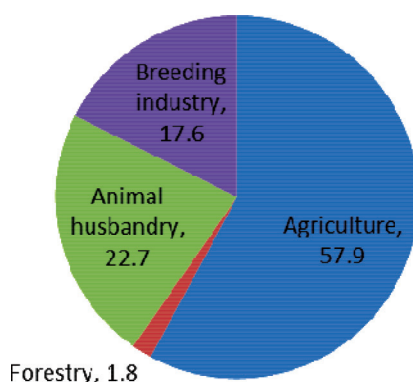


Figure 4 – Input-Output Ratio Charts

Various methods of mathematical statistics to regression analysis are applied most widely, early in the 19th century regression analysis in the face of the least square method

appears and in matrix algebra as the main mathematical tools, in the actual began 100 years and its theory and method has become increasingly rich and colorful, application of more and more widely, and the idea of regression analysis has penetrated into other branches of mathematical statistics, such as time series analysis, principal component analysis, discriminate analysis and so on (Kashfi S M H., Mojarad E N., Pourhoseingholi M A., et al., 2015).

3.2. Representation of Multiple Linear Regression Models

Regression analysis is the relationship between the studies of two or more variables statistical analysis method to reveal the internal relations between variables by determining the strength of a variable impact on other variables. A linear regression model is the most simple regression model. But in many practical problems, due to variable Y often not only with a variable related, but with multiple variables $X_1, X_2, \dots, X_p$ related variables and various factors among the variables of multivariate linear regression model are:

$$Y = \hat{a}_0 + \hat{a}_1 X_1 + \hat{a}_2 X_2 + \dots + \hat{a}_p X_p + \varepsilon \quad (1)$$

Where $\beta_i, i = 1, 2, \dots, P$ is the unknown parameters, such as $X_i, i = 1, 2, \dots, P$ is p can accurately measure and control the general variables, ε is the random error. In the regression analysis we usually assume:

$$E(\varepsilon) = 0, \text{Val}(\varepsilon) = \sigma^2 \quad (2)$$

As long as it is to estimate the regression coefficient $\beta_i, i = 1, 2, \dots, P$ is σ^2 ; regression equation (1) is fixed. Observing the n set of data, ($n > p$), n a regression model (Chellatamilan T., Magesh B., Balaji K., 2015):

$$Y_i = \hat{a}_0 + \hat{a}_1 X_{1i} + \hat{a}_2 X_{2i} + \dots + \hat{a}_{pi} X_{pi} + \varepsilon_i \quad (3)$$

Use matrix as:

$$Y = X\beta + \varepsilon \quad (4)$$

Type:

$$\begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix}, \begin{pmatrix} 1 & X_{11} & X_{12} & \cdots & X_{p1} \\ 1 & X_{12} & X_{22} & \cdots & X_{p2} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & X_{1n} & X_{2n} & \cdots & X_{pn} \end{pmatrix}, \beta = \begin{pmatrix} \hat{a}_0 \\ \hat{a}_1 \\ \vdots \\ \hat{a}_p \end{pmatrix}, \varepsilon = \begin{pmatrix} \hat{a}_1 \\ \hat{a}_2 \\ \vdots \\ \hat{a}_p \end{pmatrix}$$

Where Y is the dependent variable observation value of n -dimensional column vector, $n * (P + 1)$ matrix X said regression design matrix or data matrix and elements for

the various independent variables observed. Epsilon is the error of observation of n-dimensional column vector.

3.3. Least Squares Estimation

In physics experiments, it is often to observe the physical quantities of the two functions. The function curve is determined according to the data of many groups of two quantities. This is the curve fitting of the data processing. Such problems usually have two kind of situations: one is two measurement between X and Y is the form of the function known view, but some of the parameters are unknown and need to determine the best estimate of the unknown parameter value; another is between X and Y is a function of the form is not known and need to find out the experience formula of between them. After a situation often assume that the relationship between X and Y is an undetermined polynomials, the unknown parameters of the polynomial coefficients is determined, which can adopt similar to a processing method. The principle of least squares is for a parameter vector β b estimate of β ; the regression equation of the residual sum of squares function SSE (β) has a minimum value:

$$SSE(\beta) = (Y - X\beta) (Y - X\beta)$$
 (5)

3.4. Regression Model Test

Under a certain sample size, increase explanatory variable must make the reduction of degrees of freedom, so adjustment of the train of thought is: residual sum of squares and the total sum of squares of deviations were divided by their respective degrees of freedom, to eliminate a variable number of goodness of fit.

$$\frac{RSS/(n-k-1)}{TSS/(n-1)}$$
 (6)

Where: n-k-1 is the degree of freedom of the residual sum of squares and degrees of freedom, and N-1 is the sum of degrees of freedom. For example the consumer spending price index of urban residents in China is shown in Table 4.

	X	X1	GP	FP	XC	Q	PO	PI
1997	4185.6	1942.3	108.3	100.1	2775.5	1265.3	145.3	115.3
1998	4331.2	1926.3	103.2	96.3	2758.3	1635.2	158.3	117.2
1999	4615.2	1932.2	99.4	97.6	2736.2	1566.3	157.2	123.3
2000	4998.3	1958.3	98.7	100.7	2774.1	1529.3	169.3	128.1
2001	5309.6	2014.3	100.7	99.5	2764.3	1539.2	192.3	130.3

Table 4 – Price Index of Consumption Expenditure of Urban Residents in China

4. Actual Data Validation

According to the analysis of the application of agricultural economy, we choose three kinds of digital models: 1. Agricultural production environment recognition time series

regression and correlation degree 2. Agricultural economic input output coefficient of determination and prediction of input output model, RAS correction coefficient method. Agricultural production optimization scheme grey input output optimization model. First class: the factors of agricultural production environment for identification and prediction of the model is nothing more than the application of time series regression and correlation to solve agricultural production random, ordered or disorder, can be determined cannot determine the some factors. First and second class: using input output model solution composition, input-output ratio, initial distribution and end use composition, direct consumption, indirect consumption, wages, profits and taxes and so on. The third category: to provide the decision-making department can choose the optimization program.

4.1. Input Output Table Database and Other Application Model Automation.

It starts from the demand analysis and finally gets the whole development process of the application system. Our purpose of database automation, automation applications, and the principle of database application system based on adaptive. In dBase environment to *.PRG throughout by dictionary database control database of Chinese characters conversion, by the database after a random search to generate required library will need base maintenance after generation of *.TXT file substitution application model. Fitting the true value of the regression forecast is shown in Figure 5

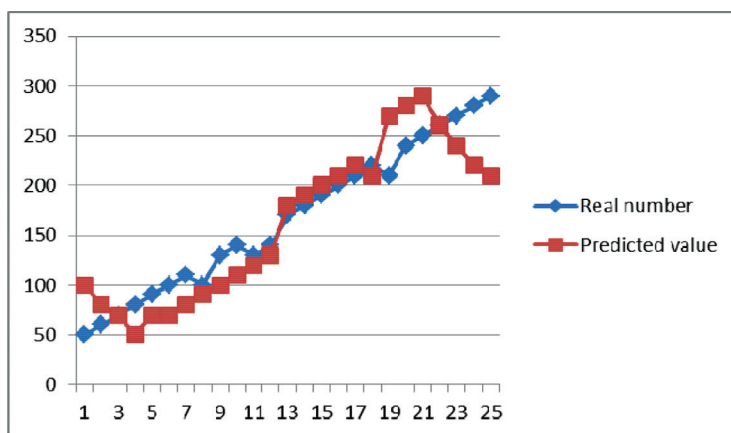


Figure 5 – Fitting the True Value of the Regression Forecast

4.2. Networking Communications

In uniform number, code based, uniform code of administrative region, city, District, county and township network communication, in a dynamic form the national economy information storage. Exchange, information sharing. Used for the input-output table to create the database, the realization of the database automation system, system for quantitative analysis of expansion is a good way, although in our country at present situation is basic data statistical work remains to be further scientific and statistical

personnel also need specialized training, and strive to get the quantitative research in agriculture had made a gratifying pace. Using the input output table is planning and management of agricultural practical method, this method can not only overcome the disadvantages of conventional methods are too simple, not a comprehensive analysis of the agricultural production in the intricate relationship, and avoid the digital model is too complicated and difficult to accept the grassroots cadres lack. It is the plan for the management of agricultural planning, production forecast. Economic input and output changes provide convenient conditions.

4.3. Econometric Model Setting.

Based on the influence of industrial structure on the economic contribution analysis, study intends to the influence of industrial structure on the economic contribution analysis model of agricultural input and output of the empirical analysis. Different investment impact on production can be expressed as:

$$Y=F(X_1, X_2... X_P) \quad (7)$$

In the formula, Y represents the total output; X input factors of production material and labor force, economic system and science and technology etc.

From the point of view of national economic statistics and national accounts, total output constant equal to all the elements of the input output, but in the economic system, some investment between the elements will be the emergence of the phenomenon of collinear, or some of the input elements of a single point of view although the contribution to the total output is no significant, but with other combination of inputs but to the total output have great influence, for this part of the production elements, see for a part of the economic system, and the other as the elements of the impact of economic system. Therefore, the total output is not equal to the simple sum of the individual outputs of all input elements.

4.4. Countermeasures of Increasing Farmers' Income

Because of the lack of water resources, leading to large tracts of land in the idle state, and water resource utilization is not full, so land resources development and great difficulty; in the southern region of farmers rely too much on the initial planting industry, agriculture and the secondary and tertiary industries and small scale, agricultural industry chain is short, agricultural products with low added value, economic and social benefits of a comprehensive level of return difference; a considerable part of the regional industrial structure is not reasonable, especially fruit planting area is relatively small, severely restricted the in the southern regions of agricultural economic output network. In view of the above problems, the development of agricultural economy should focus on the following 5 aspects.

Fully improve the land utilization rate in the adjustment of agricultural structure; each unit should be according to the existing structure, eliminating the unreasonable agricultural land. In accordance with "the reduction of cotton, increasing livestock and increasing

fruit" policy, in water limits to ensure food security and stability improve the level of cotton production premise, vigorously develop the fruit and vegetable gardening, and actively develop aquaculture characteristics. At the same time, each region of Southern Xinjiang to according to its own characteristics and the basic conditions for the development of special industries, fully improve the land utilization rate, make good use of every land and every resource, to form their own regional advantages and regional brands.

First of all, we should increase investment in agricultural mechanization, reduce labor costs and improve production efficiency. Mechanization of agriculture more and more contribution, and low level of mechanization of labor costs significantly impede the improvement of agriculture benefit, enhances the agricultural benefit potential necessary mechanization to increase investment. Secondly, to increase the agricultural investment, realize agricultural modernization, extension of agricultural industry chain, and actively promote the deep processing of agricultural products, in the liberation of the peasants labor productivity and increase the income of farmers. Through the cultivation of leading enterprises, extending secondary industry chain, increase the added value of agricultural products, the establishment and improvement of agriculture benefit coupling mechanism, realize the three times industry linkage, bred a number of benefits, high degree of association, a strong impetus to the industrialization of agriculture leading enterprises, to create a number of well-known brands.

A water resource not only is the lifeblood of the agricultural production, but also the maintenance of the ecological balance of the southern core elements, so to rational use of water resources. At present, the southern area of water resources ecological balance and land use imbalance. To southern regions of the ecological environment, protect the existing living environment should be stopped than new land reclamation, and make full use of the existing land, improve land use efficiency. In the realization of agricultural economy rapid development at the same time, considering the balance of the ecological environment, realize the harmonious development of man and nature.

In order to reduce the loss of farmers, we should strengthen the construction of personnel training, personnel training and enterprise culture. At the same time, to strengthen self-discipline of the enterprises. In strict accordance with the GMP requirements of production, so that no unqualified products into the next link.

It to strengthen customer service, analyzes demand, create demand and meet demand. At present, customer service has been extended from the basis of veterinary technical services to the expert advisory and supporting system. Focus on customer service experience; whether it is humanization of logistics distribution or policy, they are in the pursuit of psychological comfort; for in situ disease, the rapid response capability of the enterprise reflects the comprehensive quality of enterprise. For a long time, domestic animal vaccine production enterprises most of the heavy products, light service, lack of efficient technical service support for the product. And transnational enterprise has a perfect technology service system, through the effective technical and service support, make the product to increase the additional value and price of the products increases.

5. Conclusions

This paper has collected more than ten years since the agricultural input and output of the two sets of data, through statistical analysis, to reveal the internal relationship between China's agricultural input and output. The original data were quantified, in order to eliminate the dimension calculation for the inconvenience. Firstly, using the canonical correlation analysis between two groups of variables were established by canonical correlation select the variables, play a major role in the input and output variables in the two groups of variables, on this basis, to invest in the group as variables, output variables in the group as dependent variables, stepwise regression analysis, but the observation of regression analysis showed that multiplicity is very serious, some independent negative regression coefficient, and the dependent variable was negatively correlated, counterintuitive. There are many ways to eliminate the multiplicity effect, can eliminate serious collinear variables, or by The main components of the commonly used method of regression analysis, but this article first attempts to extract the common factor variables by factor analysis method, then using the selected factors on the dependent variable to do regression analysis, the regression effect is very ideal. It can eliminate the influence of multiplicity, then principal component regression analysis method, regression at analysis and comparison of the ideal factor from prediction accuracy, better than principal component regression analysis, but also has its shortcomings, is not directly from the model reflects the dependent variable dependence on independent variables, combined with factor analysis of the need to explain, and principal component regression analysis does not exist in a similar situation, the main components in this paper the fit of the regression model is higher, and the difference is not very poor. Two methods have advantages and disadvantages, so we need to choose according to the actual problems.

Using the input output table is planning and management of agricultural practical method, this method can not only overcome the disadvantages of conventional methods are too simple, not a comprehensive analysis of the agricultural production in the intricate relationship, and avoid the digital model is too complicated and difficult to accept the grassroots cadres lack. It is to form the various agriculture and related data with farm program linking up, for agricultural managers' plan, production prediction. Economic input and output changes provide convenient conditions. Choose the right method.

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The Research on the Building of University Physical Education Model Based on the Construction of Computer Multi-agent

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Abstract: physical education teaching in colleges and universities is to teach students of institutions of higher learning sports skills of important process. Over the years, the teaching reform steps never stop, the traditional sports teaching mode has gradually cannot adapt to the development of The Times, the introduction of modern science and technology teaching is imperative. Using multi-agent systems solve the problem of practical application, have the very strong coordination and reliability, and have higher efficiency of problem solving. Based on the multi-agent technology to build a suitable computer network platform to assist in the sports teaching, is to improve the teaching efficiency, cultivating students' lifelong sports awareness of the important way, establish the platform computer network auxiliary teaching is more conducive to a more comprehensive quality-oriented education, improve the teaching quality, cultivate the students' lifelong sports consciousness.

Keywords: Multi-Agent; the network platform; sports teaching.

1. Introduction

The Internet era is an era of rapid development, along with the arrival of this wave great science and technology, people some of the daily work and life have changed dramatically, with the help of a network platform has been able to help us to finish a lot of tedious work, or can't work (Panthong R., Srivihok A., 2015). With computer technology as the core, comprehensive utilization of 3 d graphics technology, multimedia technology, sensor technology and other high-tech achievements and the latest development of fusion visual, hearing, touch, as one of the Internet platform model, with the help of this people can fully himself in virtual environment created by computer, in the virtual environment, people can be directly observed around the world and the internal changes of the object, and can real time to produce the same as the real world, make the person with the computer. The computer network technology, the reference to college PE teaching process, the use of virtual reality technology features, and through it to do quantitative analysis of technical action, including the displacement, velocity, force, etc., on the basis of the techniques of college students and the "standard" action to do deep analysis, also can build a virtual training and competition environment, make up for the venue, equipment, funds and so on all kinds of practical problems existing in

the sports teaching in colleges and universities, to optimize the quality of the university sports teaching work, improve the level of university students' sports technology, further develop the students' lifelong sports consciousness (Viñoles F J C., de Azevedo Guaura R., Corrale M A, et al., 2015).

1.1. The Lack of Traditional Physical Education Teaching Mode

“Explanation and demonstration” has always been most of the physical education teaching mode, the students through the process of theoretical knowledge and practical technology can have a certain amount of understanding, and through the analysis of the teacher's classroom error correction, also can make the students have some in-depth understanding of sports technology. However, there are still some reflected in the teaching process of the practical problems, is cannot solve the traditional teaching mode (Chun-hui Z., Fu L., 2015).

Although before the end of each class, the teacher will inform the next class the task ahead of time, but students also can only be understood to learn the contents of the name, for a relative professional technique in more professional sports movement, most of the students and not immediately understand the next class to learn what is the specific content of the technical action name, lead to most students after listening, not deep impression, after also don't know what is the next time the task assigned by the teacher (Deng X., Wen Z., Wang Y., et al., 2015). Therefore, common phenomenon on the physical education is the teacher speaks what, what students go to school (Reynares, E., Caliusco, M. L., & Galli, M. R., 2014).

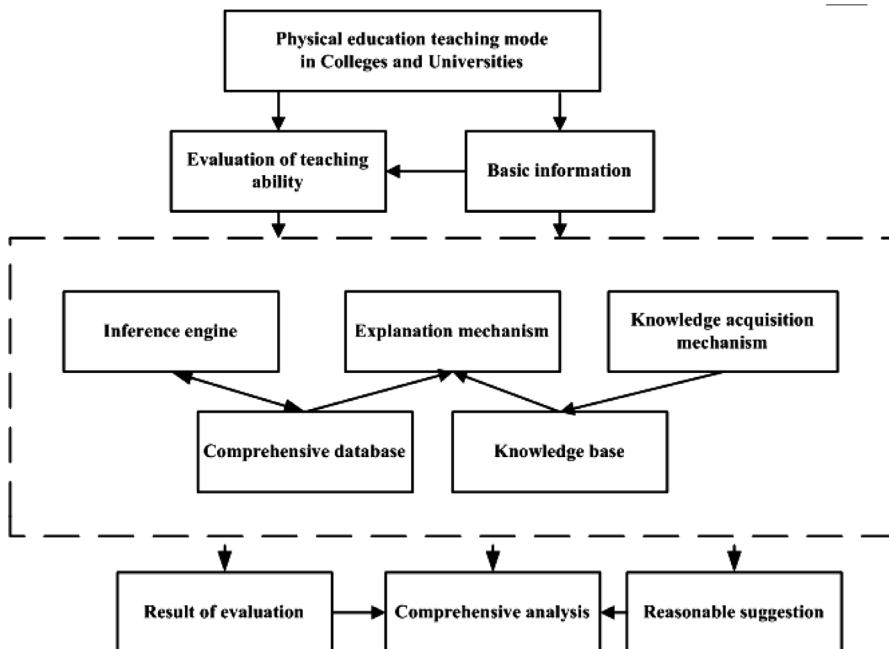


Figure 1 – Physical Education Teaching Mode in Colleges and Universities

1.2. “Explanation and Demonstration” Process Prone to “Blind Angle”

Sports classroom teaching is a relatively open place, not like in the classroom, in front of the blackboard, the teacher has blackboard writing, students in listening to explain at the same time there is a reference object. Explanation and demonstration are the common physical education teaching mode, teachers' demonstration link will have certain influence to student's study, although some have mirror demonstration projects, transposition demonstration, etc., but because the student class position problem, there is always a certain Angle can't all take care of, it is easy to cause an error due to different visual Angle in the process of learning (Shin S., Park B., 2015).

1.3. Class Period is Longer, After Class to Review A Bit Confused

While studying in the classroom, the teacher's explanation and demonstration, most of the students can better grasp of learning content, but the weekly gym class interval period is longer, because individual students practice, leads to movement technology to master is not strong, especially for some fixed routine project more apparent, such as: martial arts, sandhog, aerobics, aerobic boxing, yoga, etc (Shukla R K., Mali S R., 2015).



Figure 2 – Seminar of University Physical Education Model

2. Method Principles

2.1. College Sports Science Research Status

From the perspective of the formation and evolution of our country sports subject, it follow from the sports to carry out to the school curriculum Settings, and then to the development of professional sports, to form the general rules of sports science discipline. Sports science discipline in China's high development, has experienced from sports to at the beginning of the course to build professional, professional development and setbacks and pauses, sports discipline formation, ownership of sports science, social science and discipline refactoring, discipline with the rapid development of the six stages (Kalva H., Chen H., Adzic V., et al., 2015).

In this to introduce and learning advanced western science and technology, to achieve the “rich” self-improvement, for the purpose of activities, the westernization movement training and the construction of the modern navy and army, and employ the German coach, thus came the many contents of gymnastics in Germany. In addition, the Qing government sends students to go to England, France, manufacturing and driving, learn to cultivate technical backbone of the navy in the future. In 1877, 1881 and 1886 successively from Fujian ship administration school, be yang navy school select 78 students to study in Britain, France and other European countries. Yan Fu is a typical representative of the British students. He back home during the period of be yang navy as general teaching in school, show the attaches great importance to the modern western sports, has carried out a number of modern western sports activities, such as track and field, football, swimming, boxing movement. Founded in 1880, the westernization movement in the Tianjin navy school and began to set “gymnastics”. Content is divided into two parts, part of the physical education is a German gymnastics content, the other part is Japanese race game, including specific projects have fencing, goads, walking sticks, boxing, spoons, jump, jump, jump, football, climbing, mast, swimming, skating, platform, Trojan horse, horizontal bar, parallel bars, and mountain climbing, etc. In 1885, Tianjin armament school class, western soldiers hold was placed on the formal curriculum (Abawajy J., Fudzee M F., Hassan M M., et al., 2015).

With the development of sports practice in China, people begin to realize that the Soviet Union sports theory in our country executes limitation and obvious “water”. Sino-soviet relations deteriorated in the 1960 s, China's education and sports want to explore a new theory to replace the former Soviet Union sports theory, and then began to explore the Chinese sports development path. Published in 1961, the sports college undergraduate course teaching material the theory of sports, led by Beijing sports dean sheng series the plate (Zhou L., Zhang N., 2015). On the professional construction, there is only one in the early days after foundation of professional sports. In 1957, professional sports add to six. In 1963 the ministry of education promulgated the catalog of general institutions of higher learning professional, set up sports, track and field sports, gymnastics, ball games, swimming, water sports and professional sports, martial arts seven and start pilot sports health care professional.

As a whole, this stage of the sports theory system construction is not completely get rid of the Soviet union theory of architecture, but in terms of teaching material system, content, professional construction, to a certain extent, reflects the new China sports practice experience, for the development of Chinese sports science has played a fundamental role (Zhang Y., Wu X., Kwon O., 2015).

During the “cultural revolution”, due to the impact of the “closed” revolting, cancelled most of the region and the school physical education, teaching and scientific research to a halt, the preliminary formation of the school sports health rules and regulations, the sports teaching theory system and teaching plan, teaching content and teaching methods, etc., all said to be “seal, endowment,”. China's sports development basically at a standstill.

2.2. Multi-Agent Computers

Multi-agent, Distributed Artificial Intelligence (DAI, Distributed Artificial Intelligence) and multi-agent System (MAS, Multi - Agent System) theory provides a best way to address these challenges (Dammak B., Baklouti M., Benmansour R., et al., 2015).

Speaking of “multi-agent”, Multi-agent system is an important branch of distributed artificial intelligence, is the end of the 20th century to the early 21st century international frontier discipline of artificial intelligence. The purpose of the study is to solve the problem of large and complex reality, and solve the problem is beyond the ability of a single agent.1989 the first international conference on multi-agent Europe, marks the technology extensive attention by the researchers. 1993 agent model (international conference was held for the first time in 1994 and held its first session of agent theory, the system structure and the language of international meetings, shows that the multi-agent technology becomes more and more get attention (Tochilin P A., 2015).Such as figure 3.

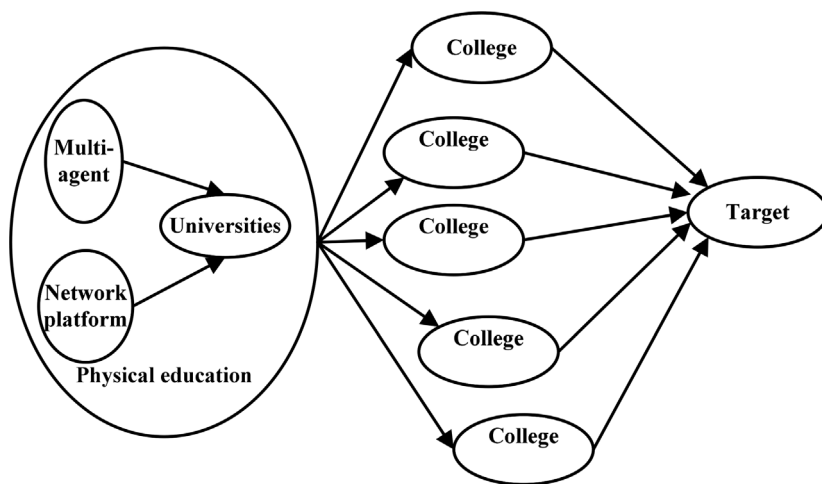


Figure 3 – Multi-Agent Network Platform

Multi-agent system is composed of multiple intelligence collection; its goal is to large and complex system into small, communication and coordination each other, easy to management system. It research involving the agent's knowledge, goals, skills, planning, and how to make the agent to take concerted action to solve the problem, and so on (Lammert H., Noel J K., Haglund E., et al., 2015).

$$F = f(Q, E, C) \quad (1)$$

Researchers mainly study the interaction between the agent communication, coordination and cooperation, conflict resolution, etc., he emphasized the intimate group cooperation between multiple agents, rather than the individual ability of autonomy and play, mainly explains how to analyze, design, and integrate multiple agent cooperation system.

$$E = P / I_u = P / \sum_{k=1}^U C_k \quad (2)$$

At the same time, people realized that the essence of human intelligence is a kind of social intelligence, most human activities involve many people form social groups, large, complex problem solving requires multiple professional or organization and coordination. To the study of social intelligence, composition of the basic building block of society - people counterparts - agent surely become the basic object of artificial intelligence research, and social counterparts - multi-agent system, has become the basic object of artificial intelligence research, so as to promote to the behavior of the multi-agent system theory, system structure and in-depth study of language communication, the great prosperity the agent technology research and development.

$$PXX+ PYY= I \quad (3)$$

$$\text{Mu}(X)/ PX = \text{Mu}(Y)/ PY =\lambda \quad (4)$$

The man-machine agent technology can build a radiotherapy (RATA PLAN) training system, the development window for human-computer interaction; realize the man-machine dialogue. Each user has its own human agent, the agent through the network communication. Can be the agent technology is applied to the intelligent teaching system development, such as remote teaching and health information system. Predictably, intelligent online schools and online intelligent hospital, in the design and development of multi-agent technology will play a role of potential immeasurable (Tarasyev A., Usova A., Wang W., 2015).

2.3. Network Platform to Assist the Universities Sports

Teaching process can be divided into three stages of before, class and after class, the class stage belongs to the teachers and students to participate in the completion, so for the other two stages, how closely linked to the teachers and students, teaching contents were extended in their spare time, causes the student to obtain more abundant learning resources and learning guidance, this needs to act as an intermediary link, set up suitable for computer network platform, is one of the most practical and most effective way. In the sports web page construction of specialized sports column of the campus network, set up a special account to log in, or use some chat software, let abundant network resources and curriculum.

$$F = I * E = \sum_{j=1}^Q C_j * (P / \sum_{k=1}^U C_k) \quad (5)$$

Under the site physical column, all or part of the syllabus and the teaching content published ahead of schedule, and keep related annotation of teaching content, and with the relevant professional sports technique of video, video data or high level of competition, so that the students can study to have a basic understanding of the content, to learn the contents of a certain psychological preparation, and then in the process of class, through the further explanation and demonstration of the teacher, causes the student to have a closer sense, this model for some more difficult to master sports technology is very necessary, because with only one of the lesson time to temporary master never exposed

to a sports skill, for some students still have certain difficulty, know in advance before class teaching content, and have relevant text and video data, then these work to more than one class can achieve the effect.

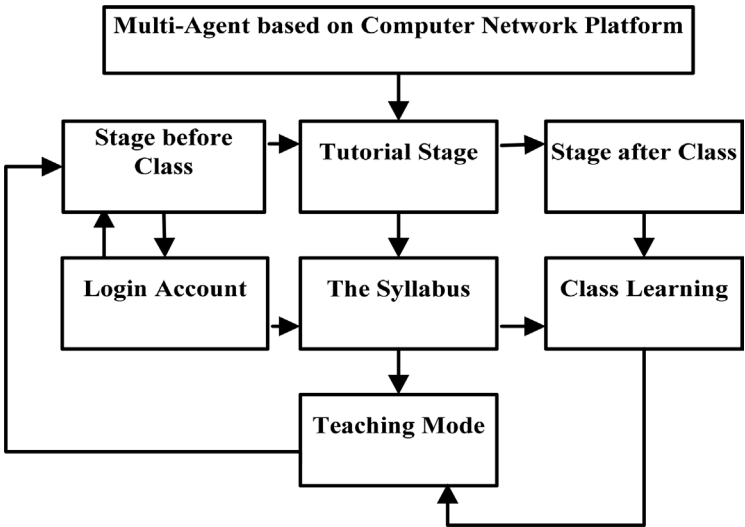


Figure 4 – Multi-Agent Based on Computer Network Platform

In class teaching process, each project has error correction analysis link, but the teachers in this link is only for general error correction is easy to make mistakes, that's clearly not cannot meet the needs of individual students, didn't get the answer due to various reasons, after class and practice, and finally result in wrong action left hidden trouble, learn knowledge could not digest, affect the subsequent technology study. To establish a teaching process under the network platform to help students outside of class learning, stretched the physical education of the section in the spare time, for the cultivation of the students' learning and lifelong sports consciousness is key. After class, teachers can be set in a time period for students in answering questions online, or about the content of this lesson, combining previous teaching experience, the course content of some common questions and solutions, published in the form of questions and answers after class to the network platform, the students after login to self-help find conforms to the solution of the problem itself, makes the study question in their spare time to get the teacher's guidance.

For some more hands-on demonstration to guide students want teachers, we can build the next lesson in teaching mode. Class due to the different physical education for the same grade, at the same cycle of teaching content, belongs to the repetition of teaching, and physical education teaching places relatively open, have this kind of space superiority, so the teacher according to the actual circumstance of their courses, such as teaching venues, equipment, etc., can be appropriately in the network platform to set several next time in places, itself is not affected under the premise of the teaching process, and allowed to make an audit qualification of students in the next week before the new lesson, in the same teaching content of different class's and grade's class

this week, the students according to their own curriculum, with no time to choose to attend class, digest class does not address the problem, this will again feel the teacher's explanation and demonstration, the acceptance for some poor students are of great help.

3. Actual Data Validation

Domestic undergraduate universities have opened many emerging interdisciplinary courses related to sports information technology; Various colleges and universities sports education professional courses in sports information technology in the compulsory basic similar, are the basic operational knowledge of information technology (computer); In elective course, the differences between colleges, higher selectivity of students, is beneficial to the all-round development of sports talents. But the overall curriculum also has many shortcomings, mainly displays in: the beginning of curriculum knowledge is low, not enough comprehensive, update is slow; Curriculum structure is not reasonable and practical application, the lack of pertinence.

	Frequency	Percent	Valid Percent	Cumulative Percent
<i>Through a systematic training</i>	270	47.5	47.5	47.5
<i>Just had practiced for the games</i>	56	16.9	16.9	64.4
<i>Only practiced before the physical test</i>	144	28.3	28.3	92.7
<i>Not yet trained</i>	30	7.3	7.3	100.0
<i>Total</i>	500	100.0	100.0	

Table 1 – Statistical Data of the Training History

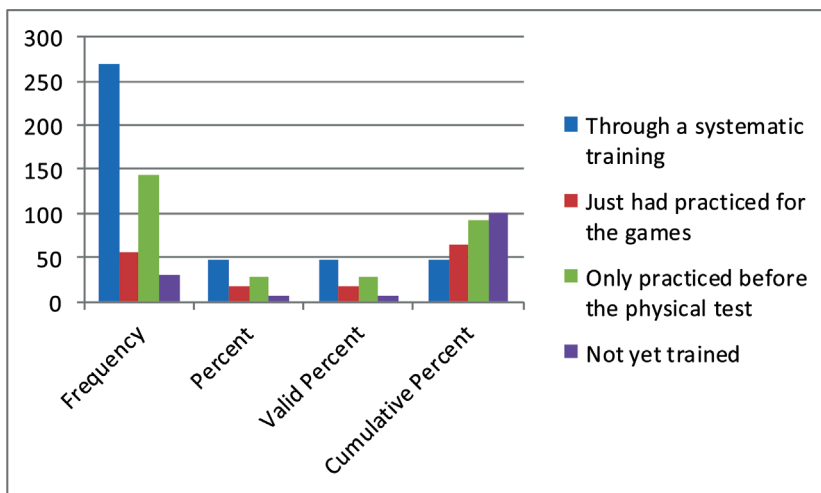


Figure 5 – Statistical Data of the Training History

As can be seen through the study of this article, both the content of the web platform setting and the effect of network teaching platform is to a certain extent, have obvious improve, but we should also know that such a multi-dimensional teaching system is the need to influence of various factors such as the subjective and the objective teaching entity or network dummy, need certain basis, all need to schools, teachers, students and network and so on various aspects to have reached a consensus, form a circle of the community, the cycle, but also put forward higher requirements for colleges and universities sports teaching.

	Frequency	Percent	Valid Percent	Cumulative Percent
<i>Knowledgeable</i>	68	10.5	10.5	10.5
<i>General</i>	312	67.5	67.5	78.0
<i>Barely</i>	74	13.8	13.8	91.8
<i>Poor</i>	46	8.2	8.2	100.0
<i>Total</i>	500	100.0	100.0	

Table 2 – Statistical Data of Cultural Accomplishment

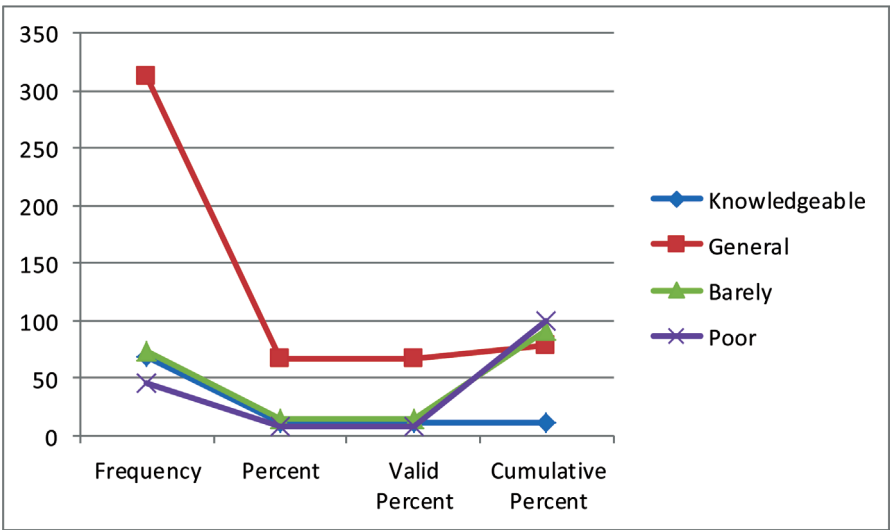


Figure 6 – Statistical Data of Cultural Accomplishment

Network for college teachers put forward higher request, asked each teacher to not only can be related in the sports classroom teaching content, to grasp by the application of multimedia technology in the extension of classroom teaching. And establishment of the network teaching platform will need to each college volleyball teachers can participate in which, through the network to meet the requirements of the sports teaching in colleges and universities in Heilongjiang province is the university volleyball teaching outline, thus teachers not only to the practical teaching of volleyball class, but also for his take

on the network teaching content for the early planning, on the one hand, through the network of colleges and universities in Heilongjiang province volleyball teachers to have more communication and discussion between platform structures, on the other hand, teacher resources and network resources integration and optimization.

Year	2008	2009	2010	2011	2012	2013	2014	2015
<i>Electrical</i>	115.31	116.45	114.64	115.81	115.84	115.13	113.69	114.32
<i>Management</i>	115.31	126.28	123.77	130.96	134.21	133.02	138.73	149.71
<i>Law</i>	0.00	9.83	9.13	15.15	18.37	17.90	25.04	35.39
<i>Information</i>	115.31	117.08	125.70	131.48	145.96	176.92	193.21	214.96
<i>Other</i>	0.00	0.63	11.06	15.67	30.12	61.79	79.53	100.64

Table 3 – The Service Efficiency of the Department

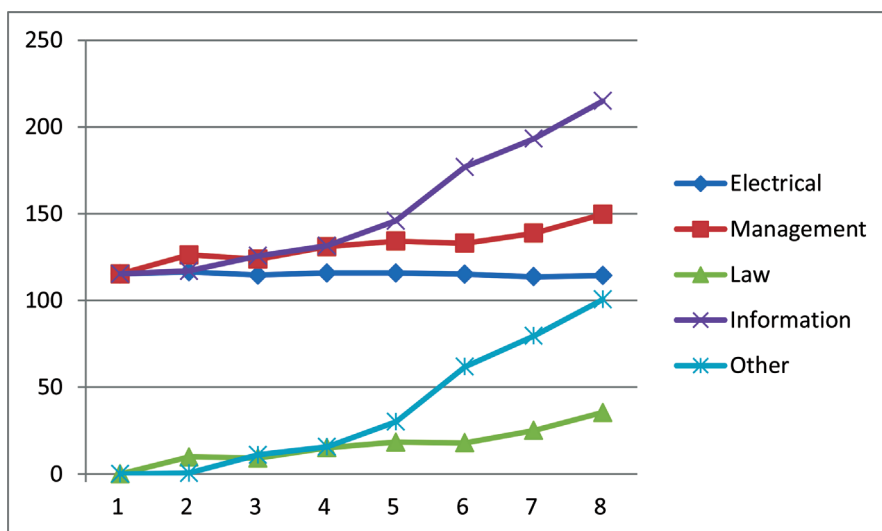


Figure 7 – The Service Efficiency of the Department

Either a terminal is a part of the system, the network teaching system into the normal teaching, as an extension of classroom teaching, of course, such a system does not only depend on a unit can improve and maintain, need every participating colleges and universities are the real part of this system, enables the system to the real use by students, rather than as a decoration, make students learn by the network platform of real benefit, real learning. And the problem of students in the use of reaction in the process of teaching and Internet technology problems were perfected and improved, in order to make the whole system more humane, scientific and easy to operate.

4. Conclusions

In today's rapid development of science and technology, computer-aided multi-agent network platform for sports teaching is imperative, voice, text, images, animation technology is the traditional teaching mode cannot be achieved, such as the use of technology to enrich our teaching, teaching process is more comprehensive, more rigorous, it would also be an important innovation in the teaching reform, establish the platform computer network auxiliary teaching is more conducive to a more comprehensive quality-oriented education, improve the teaching quality, cultivate the students' lifelong sports consciousness.

A strategic measure of the development of sports science in colleges and universities mainly include: the standardization of the sports science discipline construction theory; To reconstruct the sports discipline system; Optimization of aid policy, increase the intensity of funding; To strengthen the construction of talent team; Promote the cross research of organization innovation between different disciplines; To carry out the collaboration and cooperation between different channels; Innovation international academic cooperation and exchanges; Establishing and perfecting the "infrastructure", build a good platform for academic research; Subject combined with skill, encouraging collaborative innovation; Strengthen applied research, increase the degree of research achievements transformation of science and technology; Actively promote the sports course of the construction of the hierarchical and systematic process.

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Financial Risk Early Warning Model of Public Hospital Liability Management Based on Data Mining

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Abstract: With the increasingly fierce competition in the medical market, financial risk has become a real problem in the process of public hospital management. So the financial risk early warning model of public hospital liability management based on data mining is proposed in this paper. The theories of financial risk early warning and data mining are briefly introduced on the basis of previous studies, three kinds of data mining techniques used in this paper are described, and the design process of early warning model is given, the Logistic regression, neural network and decision tree are used to construct the financial risk early warning index system, then the prediction effect of the model is evaluated by using the numerical model, which makes the evaluation more objective. The validity of this model is proved by experiment. The system studied in this paper can effectively restrain the development of financial risk, reduce the loss of financial risk, and promote the healthy and sustainable development of public hospitals.

Keywords: Data mining; financial risk early warning; decision tree; neural network.

1. Introduction

The focus of future government health investment is mainly used to support public health, rural health, urban community health and basic medical security, and to encourage and guide the social capital to develop medical and health service. It can be seen that the government investment in large and medium-sized hospitals will not increase significantly, and the social capital to set up medical institutions will make the medical market competition more intense. At the same time, the financial risk also gradually penetrates into the various fields of hospital with the operations of hospital, which is directly related to the survival and development of public hospitals. (Reynares, E., Caliusco, M. L., & Galli, M. R., 2014) How to dig out the information that helpful for the hospital financial risk early warning from a large number of financial data in the public hospital management process has become an important problem that needs to be solved. The continuous development of data mining techniques and methods solves this problem. It can extract key data from a large number of business data in the enterprise and analyze the data at a high degree of automation, then make inductive reasoning, so as to dig out the potential model, help the decision maker to adjust marketing strategy, and reduce the risk, make correct decisions. The purpose of this paper is to apply the

powerful advantage of data mining technology to the financial risk early warning. Based on the thinking and exploration of the financial risk data processing and analysis method, this paper uses the advantages of data mining processing to make up for the deficiency of financial risk early warning data, uses Logistic regression, neural network and decision tree to establish a financial risk early warning model, and based on this, the preliminary financial risk analysis and financial crisis prediction are carried out. At present, the research of financial risk early warning is still in infancy, and the application of data mining technology in the hospital is not much. Therefore, the topic of this paper has some research value and practical significance (de Faria Silva, I., Souza e Silva, L., Alves Carneiro, C., Assis Peixoto, Z. M., & Magalhaes Freitas Ferreira, F., 2016).

2. Research Status

With the continuous development of computer technology and information technology, as a new business information processing technology, data mining has the ability to extract the hidden, unknown, potentially valuable information from the database. Since the 80's, western researchers have begun to use artificial neural networks, expert systems, genetic algorithms and other knowledge discovery class data mining technology for financial risk early warning research. The application of these methods in enterprise financial analysis and rating shows the advantages and potential, that is, there is no restriction to the sample distribution, and the scope of application is wide. (Raj, S., Maurya, K., & Ray, K. C., 2015) Therefore, the use of knowledge discovery class data mining technology is an important development trend of the financial risk early warning research methods. Foreign researches on financial risk are more and mature. The neural network model was used to predict and analyze the credit risk of bank (Hu, B., & Li, B., 2016). The bankruptcy of company was predicted effectively through neural network system with the accuracy rate of up to 97% (Montanari, A., 2015). The use of the model based on the inductive rule method was more accurate than the multiple discriminant analysis model to carry on the bankruptcy prediction in the changing economic environment (Miyamoto, K., Kuwano, S., Terada, J., & Otaka, A., 2016). The advantages of the genetic algorithm in the prediction of bankruptcy are compared and analyzed (Nguimdo, R. M., Verschaffelt, G., Danckaert, J., & Van der Sande, G., 2016). Domestic research on enterprise financial risk early warning is relatively late. The decision tree technology was applied to set up the financial risk early warning system of the listing corporation in china (Abbass, H., Guan, C., & Tan, K. C., 2016). A multivariable nonlinear financial early warning model was established on the basis of the decision tree and artificial neural network (Eberle, L. S., 2015). The research results show that these systems have good predictive ability, and have good application prospects in this field. However, in the process of studying the financial risk early warning model, there are some problems as follows: The big error of system affects the result of the empirical study, the early warning index is not consistent, modeling method lacks of innovation. In view of the above problems, this paper uses Logistic regression, neural network and C5.0 decision tree in data mining technology to establish public hospital financial risk early warning model on the basis of previous studies, and the prediction effect of the model is evaluated by using the numerical model, which makes the evaluation more objective. (Tolaba, A. C., Caliusco, M. L., & Galli, M. R., 2014) The remainder of this paper is organized as follows. Section 3 describes the related theories and key technologies: such as Logistic regression, neural network, C5.0

decision tree and so on. Section 4 gives the design and construction process of financial risk early warning model, as well as, the instance operation. Section 5 presents a real experiment to evaluate the model. Conclusion is summarized in Section 6 (Mahmood, A. S., Rahim, M. S. M., & Othman, N. Z. S., 2016).

3. Related Theories and Key Technologies

3.1. Financial Risk Early Warning Theory

Financial risk is one of the enterprise risks, it is the concentrated expression of the total risk of enterprise management in financial activities, and it is the possibility of the actual result of enterprise's financial activity to deviate from the expected result. (Sucheran, R. E. S. H. M. A., 2015) Financial risk early warning refers that the enterprise operating activities, financial activities are analyzed and foretasted on the basis of the enterprise's financial data, and the potential business risk and financial risk in the business operation and management activities of the enterprise are found out to send warning to corporate stakeholders before the crisis, so as to provide decision-making basis for managers and stakeholders, (Rahati Belabad, A., Iranpour, E., & Sharifian, S., 2015) and reduce the loss of the maximum. This paper uses data mining technology to warn financial risk early, and fully taps the potential model between financial data and financial risk.

3.2. Data Mining Theory

Data mining is also known as the database knowledge discovery, which refers to the process that the hidden, unknown but potentially useful information and knowledge are extracted from the large, incomplete, noisy, fuzzy, random, and practical data by using various analytic tools. (Leite, V. C., Veloso, G. F., da Silva, L. E. B., Lambert-Torres, G., da Silva, J. G. B., & Pinto, J. O. P., 2016) Data mining is a multi processing stage, data mining process is mainly composed of three processes: data preparation, data mining, results evaluation, the whole process is a continuous cycle and repeated process. The main purpose of data preparation is to extract data from the database according to the user's requirements, and to ensure the integrity and consistency of data. Data mining mainly includes: determining the purpose of data mining, using the correct and efficient algorithm to extract the knowledge from the database. Results evaluation means: explaining and presenting the knowledge to the user in the way that the user can understand (Kawasaki, H., Torigoe, K., Ohta, M., & Yamashita, K., 2016).

3.3. Data Mining Technology

3.3.1. Logistic Regression

Dependent variable Y_i is the two variable. Data must be derived from random samples. The dependent variable Y_i is assumed to be the function of k independent variables x_k ($k = 1, 2, \dots, k$), the relationship between the dependent variables and independent variables is nonlinear. There is no multiple co linearity between the independent variables. In this paper, the financial risk early warning model is established as an example to illustrate the principle of Logistic regression analysis. Setting: dependent variable $Y=0$ represents the financial crisis company, $Y=1$ represents the normal financial company. P represents



Figure 1 – Data Mining

the probability of occurrence of financial crisis of $Y=0$, $P_1=1-P$ represents the probability of non occurrence of financial crisis of $Y=1$.

$$\log it(p_1) = \ln \left[\frac{p_1}{1-p_1} \right] = \alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k \quad (1)$$

$$P_1(Y_i = 1) = \frac{\exp(\alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k)}{1 + \exp(\alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k)} \quad (2)$$

$$P(Y_i = 0) = 1 - P_1 \frac{1}{1 + \exp(\alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k)} \quad (3)$$

$x_1, x_2, \dots, x_k$ are the independent variables, $\beta_1, \beta_2, \dots, \beta_k$ are the regression coefficients corresponding to the independent variables, α is the intercept. Among them, the regression coefficient $\beta_1, \beta_2, \dots, \beta_k$ and the intercept α are obtained by the maximum likelihood method. 0.5 is selected as the dividing point of the logistic regression model. When the company's $P < 0.5$, the company can be judged for the non ST company; and when the company's $P > 0.5$, the company can be judged for the ST company.

3.3.2. Neural Network

The neural network is the basic function and characteristic of the human brain, and it is processed by the state response of the input of the continuous or discontinuous mode. It is suitable for dealing with the imprecise and fuzzy information processing problems. Neural networks are characterized by distributed storage and fault tolerance, massively parallel processing, self-learning, self-organization and self adaptation and so on. The structure of BP neural network is usually composed of three layers: input layer, hidden layer and output layer. The hidden layer is between the input layer and the output layer (it is not visible to the users of the neural network), the number of layers and nodes in the

hidden layer determines the complexity of the neural network. Neural is a information processing unit of neural network, which is the basis for the operation of the neural network. In the following formula, $x = (x_1, x_2, \dots, x_n)$ is the neuron input, $w = (w_{1i}, w_{2i}, \dots, w_{ni})$ is the connection weights, and θ is the threshold, U and F respectively represent the basis function and activation function of the neuron, which is the arithmetic unit of the neuron. BP neural network and multilevel perception use linear function as the basis function, the formula of the linear function is:

$$U = \sum_{m=1}^n x_m w_{mi} - \theta_i \quad (4)$$

Sigmoid is:

$$F(x) = \frac{1}{1 + e^{-x}}, \quad (5)$$

Output:

$$y_i = F\left(\sum_{m=1}^n x_m w_{mi} - \theta_i\right) \quad (6)$$

3.3.3. Decision Tree

Decision tree is mainly used in classification and prediction. It uses the top-down recursive way and the information theory principle to carry on the comparison of attribute values in the internal nodes of the decision tree, and according to the different attribute to judge the down branches from the node and get the conclusions on the leaf nodes of decision tree. Common decision tree algorithms are ID3, C4.5, C5.0 and so on. Since Clementine provides the C5.0 algorithm as the decision tree modeling algorithm, so the generation process of the C5.0 decision tree is introduced. C5.0 uses the maximum attribute information gain rate to select attributes. The calculation method is as follows: Setting T is the data set, the category set is $\{C_1, C_2, \dots, C_k\}$, and selecting a property V to divide T into a plurality of sub sets. Setting: V has different values $\{v_1, v_2 \text{ and } \dots v_n\}$, then T is divided into n subsets $T_1, T_2, \dots, T_n$, here the values of all the instances are V_i in T_i .

Ordering: $|T|$ is the number of examples of data sets T , $|T_i|$ is the number of examples of $V=v_i$, $|C_j| = \text{freq}(C_j, T)$ is the number of examples of the C_j class, $|C_j v_i|$ is the number of examples of C_j category in the $V=v_i$ example. Then:

Occurrence probability of class C_j :

$$P(C_j) = \frac{|C_j|}{|T|} = \frac{\text{freq}(C_j, T)}{|T|} \quad (7)$$

Occurrence probability of attribute $V=v_i$:

$$P(v_i) = \frac{|T_i|}{|T|} \quad (8)$$

Conditional probabilities of class C_j in the attribute $V=v_i$:

$$P(C_j | v_i) = \frac{|C_j v_i|}{|T_i|} \quad (9)$$

Class information entropy,

$$H(C) = -\sum_{j=1}^k P(C_j) \log_2(P(C_j)) = -\sum_{j=1}^k \frac{freq(C_j, T)}{|T|} \times \log_2 \left(\frac{freq(C_j, T)}{|T|} \right) = \inf o(T) \quad (10)$$

Information gain, mutual information,

$$I(C, V) = H(C) - H(C|V) = \inf o(T) - \inf ov(T) = gain(V) \quad (11)$$

Information entropy of attribute V,

$$H(V) = -\sum_{i=1}^n P(v_i) \log_2(P(v_i)) = -\sum_{i=1}^n \frac{|T_i|}{|T|} \times \log_2 \left(\frac{|T_i|}{|T|} \right) = split \inf o(V) \quad (12)$$

Information gain rate,

$$gain_rato = \frac{I(C, V)}{H(V)} = \frac{gain(V)}{split_inf o(V)} \quad (13)$$

4. Construction of Financial Risk Early Warning Model

4.1. Research and Design of Early Warning Model

In this paper, the design of the early warning model is shown in Figure 2 and Figure 3. According to a certain standard to select the sample companies, that is, selecting the public hospitals that have occurred in the financial crisis and the normal financial public hospitals. It is mainly to determine the financial data indicators that have warning function to the company's financial risk, and access to the financial indicators data before the financial crisis. Through the T test and mean comparison, the mean difference characteristics of the financial crisis ST and the normal non ST company are analyzed, and the reasons of the ST company's financial risk are explored, so as to screen out a significant difference input variables of the early warning model. Model input variables are selected to be further reduced by using factor analysis model. The goal of which is to eliminate the multiple co linearity between variables, and to improve the accuracy of model prediction. The Logistic regression model, neural network model and C5.0 decision tree model are established by using the selected financial index data. Evaluation model is mainly to evaluate the model prediction effect, in this paper, the test samples are used to compare and analyze the empirical test results of the three early-warning models, the numerical and graphical evaluation criteria are used to make the evaluation results more objective and reasonable.

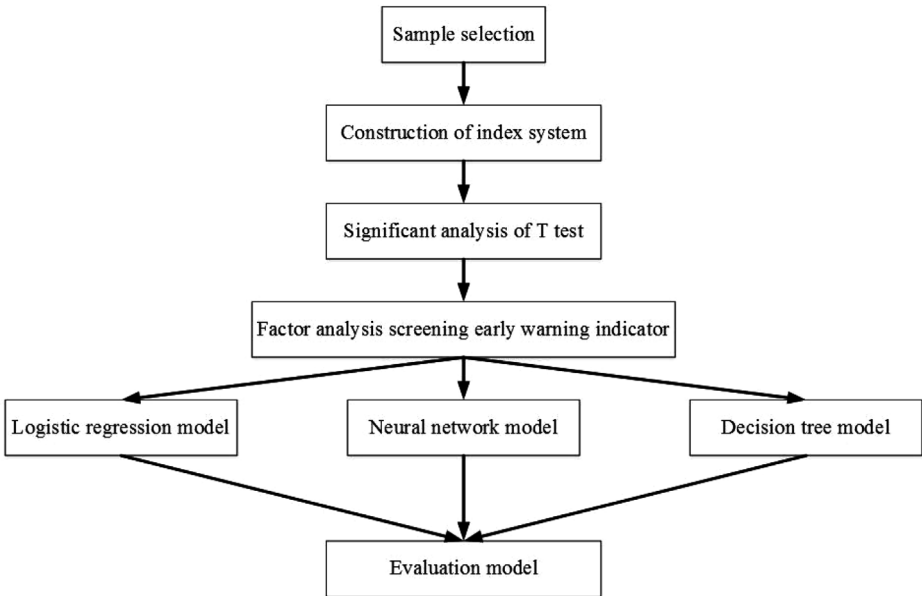


Figure 2 –Flow Chart of Research

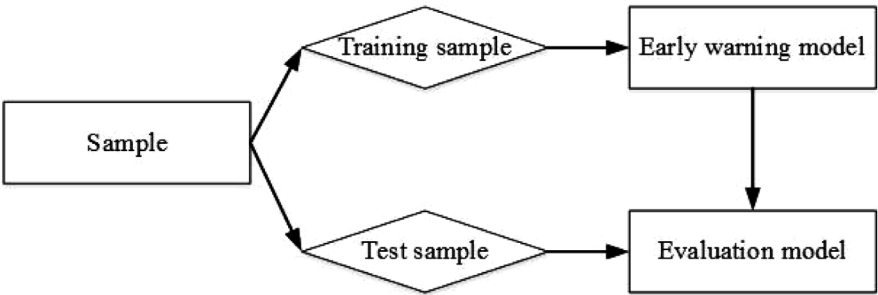


Figure 3 –Flow Chart of Early Warning Model Development and Evaluation

4.2.Weight Distribution of Financial Risk Assessment Index

Weight refers to the proportion of financial risk assessment indicators in the total score, which indicates the importance of the financial risk indicators in the early warning model, and it is also the value that has the numerical balance function to the target value. When the index weight is determined, the financial security of the hospital should be taken as the goal. In view of the internal and external environment changes, the corresponding adjustment should be made, and the weight coefficient of all indexes is 100%.The weight proportion of each index should show obvious difference, the weight of the relatively important index is relatively high. In order to avoid the deviation caused by the subjective weight and objective weight, the subjective weight and objective weight should be integrated respectively, it can make up for each other, and play their own advantages, so as to make the weighting results more scientific, accurate and reasonable.

4.3.Synthesis of the Composite Index of Financial Risk

Comprehensive index method is a basic calculation form of the compiling comprehensive evaluation value, it combines multiple metrics reporting period data (or data) and compares the information of the period data (or standard data), and quantitatively expresses the comprehensive average variation degree of several indicators, it is a kind of method that the social economic phenomenon that can't be added directly together is reduced to the value form to carry on the contrast. Therefore, the comprehensive index method can be used to make a comprehensive analysis to the financial risk of the hospital. Due to the calculation units and the nature of each index are different, the comprehensive index method can't directly carry on comprehensive evaluation, it is necessary to carry out standardization to the index.

4.4.Define the Level of Financial Risk

Scientific definition of hospital financial risk level can help hospital managers to monitor the hospital whether has business risk and financial crisis from the longitudinal angle dynamic, and according to the different risk levels to adopt the corresponding countermeasures. Which not only can help managers compare with the competitor from the horizontal angle, but also understand the level of hospital financial risk status in the same industry. Division of financial risk in public hospitals is as shown in Table1.

Alert level	Risk index	Description
<i>Red alert</i>	$K < 60$	At a high level of financial risk, the financial situation is very poor.
<i>Orange alert</i>	$60 < K < 70$	At a high financial risk, the financial situation is poor
<i>Yellow alert</i>	$70 < K < 80$	At a relative high financial risk range, the financial situation is bad
<i>Blue alert</i>	$80 < K < 90$	At the light of the financial risk, the financial situation is good
<i>Green alert</i>	$K > 90$	At a safe financial risk range, the financial situation is very good

Table 1 – Financial Risk Warning Interval Table

4.5.Instance Operation

Based on the information data and the evaluation results that collected by the financial risk assessment department of a municipal hospital in Sichuan province, the actual value of the hospital's early warning indicators is obtained. Through the application of the financial risk early warning model, and then the evaluation index is carried on the non dimensional and comprehensive index calculation, the current risk assessment results are obtained. As shown in Table 2.

From the scores of table 2 can be seen that the hospital's comprehensive assessment of the financial risk is 83.48 points, which ranges from blue alert interval, and belongs to a mild financial risk. It shows that the current business development of the hospital is relatively stable, the overall financial situation is good. It is necessary to do specific analysis to the situation of the indicators deviate from the standard value with the overall conclusion, and to help to find out some defects in management and prevent potential risks.

Dimension	Early warning index	Standard value	Weight coefficient	Actual value	Score	Comprehensive score
<i>Debt paying ability 30%</i>	Asset liability ratio	50%	12%	37%	8.76	83.48
	Activity ratio	200%	10%	200%	10.00	
	Quick ratio	100%	8%	100%	8.00	
<i>Operational capability 35%</i>	Turnover rate of medical care	3%	7%	2.64%	6.16	
	Drug turnover rate	3%	8%	2.2%	5.87	
	Turnover rate of current assets	1%	8%	0.95%	7.60	
	Turnover ratio of total assets	0.8%	12%	0.5%	7.50	
<i>Profitability 15%</i>	All capital earnings rate	30%	7%	25%	5.83	
	Balance of payments	10%	8%	5%	3.89	
<i>Development ability 20%</i>	Growth rate of business income	20%	10%	30%	15.00	
	Turnover rate of net assets	8%	5%	4%	2.50	
	Turnover ratio of total assets	10%	5%	5%	2.37	

Table 2 – Financial Risk Early Warning System in Public Hospitals

5. Evaluation of Experimental Model Results

Numerical evaluation of the model is carried out in this paper, and now the test samples are used to test the model, the process is similar to the process of testing sample modeling. The prediction results of the model in T-2, T-3 and T-4 are obtained, as shown in the following table:

Particular year	Category	0	1	Correct rate of discrimination	Total correct rate
<i>T-2</i>	0	16	1	94.2%	88.2%
	1	3	14	82.3%	
<i>T-3</i>	0	14	3	82.3%	79.4%
	1	4	13	76.5%	
<i>T-4</i>	0	12	5	70.6%	70.6%
	1	5	12	70.6%	

Table 3 – Model Prediction Results

From the overall prediction accuracy, using logistic regression, neural network and C5.0 decision tree method to carry on the financial crisis prediction of the data before the

2-4 years is correct, and with the approaching of ST time, the predictive accuracy is rising. This shows that the early warning of public hospital financial risk has a strong timeliness. In addition, the use of fourth years of data and neural network, C5.0 decision tree model makes the accuracy rate reach 73.5% and 70.6% respectively. This shows that the financial data in the fourth years before the crisis has begun to have significant differences between the two types of hospitals. So the use of the financial crisis before the first several years of data has a certain degree of rationality.

6. Conclusion

With the rapid development of economy, the risk of financial risks to public hospitals is increasing, it not only affects the survival and development of the hospital, but also brings huge losses to the relevant stakeholders. Therefore, how to timely and effectively prevent or restrain the development of financial risk, reduce the loss of financial risk, and promote the healthy and sustainable development of public hospitals becomes an urgent problem to be solved. The continuous development of data mining techniques and methods solves this problem. This paper briefly introduces the theories of financial risk early warning and data mining on the basis of previous studies, describes three kinds of data mining techniques used in this paper, and gives the design process of early warning model. The Logistic regression, neural network and decision tree are used to construct the financial risk early warning index system, then the prediction effect of the model is evaluated by using the numerical model, which makes the evaluation more objective. The validity of this model is proved by experiment. The system studied in this paper can effectively restrain the development of financial risk, reduce the loss of financial risk, and promote the healthy and sustainable development of public hospitals. The application of data mining in the financial risk early warning is a very broad topic. However, due to the limited time and data, there are still some imperfect places need to study in the further. Because of the defects of the theory and model, the financial risk early warning model established in this paper can't be broken down to the extent of the financial crisis. Therefore, in the future research, it is needed to strengthen the research on this problem from two aspects of theory and model.

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Graphic Design Research Based on Computer Graphics and Image Software

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Abstract: Contemporary graphic design has produced great changes with the continuous development of the development of society, science and technology. Obviously these changes occupy many different areas of technology into the field of design. Computer graphics imaged from 1990s, when the combination of art and technology at the non-material level had led to the birth of a new art. This paper aims to computer graphics software technology will be integrated into the graphic design, and also cites examples of some specific design style and analyze the characteristics of the design, allowing designers to become richer, more diverse forms. Computer graphics and image processing in digital media manufacturing, production, storage and dissemination, the vocabulary of art showing a multi elemental, confounding and scene, greatly enriched and expanded the vision of the traditional visual arts, digital graphic image can synchronized with the development of time and space, now many software are developed to finish graphic design such as CAD, CAE, Photoshop, etc. In this paper, different type of software was analyzed to make a contrast, at the same time, the development trend of computer graphics and image software of graphic is discussed.

Keywords: Computer graphics; software; graphic design.

1. Introduction

Graphic design, also known as visual communication design, it is a way of communication and expression, through a variety of ways to create and combine symbols, images and text. Graphic designer may use professional skills in typography, visual art, page, computer software, etc., to achieve the purpose of creation program. Graphic design usually refers to the process of making design, as well as the final completion of the work. Common uses of graphic design include identification (branding and branding), publications (magazines, newspapers and books), print ads, posters, billboards, web graphic elements, logo and product packaging. For example, product packaging may include a logo or other artwork, layout of text and pure design elements, such as a unified style of image, shape, size, and color (Uhler, K., Biever, A., & Gifford, R. H., 2016). Combination is one of the most important characteristics of graphic design, especially when the product is used in the presence of pre-existing materials or a variety of elements (Abreu, A., Rocha, Á., Cota, M. P., & Carvalho, J. V., 2015).

In 1950s, the United States, Massachusetts Institute of Technology, developed a tornado graphics display (Dettman, S. J., Dowell, R. C., Choo, D., Arnott, W., Abrahams, Y., Davis, A., ... & Briggs, R. J., 2016). In 1952, Ben F. Laposky used the computer image depicts the Lissajous curve, it is the use of computer graphics, the creation of the first image (Mooventhana, A., 2016). In late 1950s the old Whitney began to control the movement of the camera, produced a lot of animation and television commercials (Amnuaywattakorn, S., Sritara, C., Utamakul, C., Chamroonrat, W., Kositwattanarerk, A., Thamnirat, K., & Ongphiphadhanakul, B., 2016). In 1962, the first computer art and design hardware system was born in the United States (Nair, B. T., Sanjeev, R. K., & Tarikjot, S. B., 2016). In 1963, Michael Ber used computer graphical technology to create <<Gaussian Quadratic>> (Noble, J. H., Hedley-Williams, A. J., Sunderhaus, L., Dawant, B. M., Labadie, R. F., Camarata, S. M., & Gifford, R. H., 2016).

Graphic design is now designed in all walks of life where have appeared, it is essential in our lives, and it is closely related with any elements, with the development and progress of society, the continuous improvement of people's living standard, the design has become more aggravated, in life bit by bit, graphic design is the modern art design, it is the organic combination of cultural and commercial with other industries interaction, mutual blend composed, graphic design are very inclusive, it contains the knowledge of various subjects, such as: text, images, symbols, etc. With the rapid development of science and technology, application of computer technology and information network has gone deep into our life, especially for our designers, almost constantly does not use the computer and the Internet, computer technology has and all levels of our life and work has a close contact, and computer technology combined with design is on course, computer graphic and image design inevitably quickly to participate in the art design and creation process, and continue to penetrate into the design work, more influence and change the design.

2. Trend Analysis on Computer Graphics

2.1. Introduction of Computer Graphics

Computer graphics or digital image means using computer to finish digital recording or processing, in the early 90s of the 20th century, the continuous development of computer technology, which is driven by the computer related industries to flourish, computing machine graphics and image processing technology is appeared in this period, as a new industry, computer graphics and image processing technology has very broad prospects for development, like CAD, CAE, Photoshop, etc (Bollich, K. L., Hill, P. L., Harms, P. D., & Jackson, J. J., 2016). These software between organic combination to subjective operation of image processing. Graphics are real, and the image is controlled by people's subjective consciousness. These two items can be effectively combined by computer graphics and image processing technology. Computer graphics and image processing technology continue to progress with more and more harmonious, it is playing a more and more important role in various related fields, the subject has gradually developed into a dynamic of a subject. Computer graphics and image processing in digital media manufacturing, production, storage and dissemination, the vocabulary of art showing a multi elemental, confounding and scene, greatly enriched and expanded the vision of the traditional visual arts, digital graphic image can synchronized with the development

of time and space, realistic recording the reality and unrestrained beyond reality, thus showing a bright dazzling, magic is also true of the appearance of art, and its production and dissemination of economic develop fast and precisely adapted to the modern fast rhythm, passionate sense of psychological needs.

NAMES	CAD	CAE	Photoshop	Others
MARKET SHARE	35%	20%	40%	5%

Table 1 – The Market Share of Computer Graphics Software

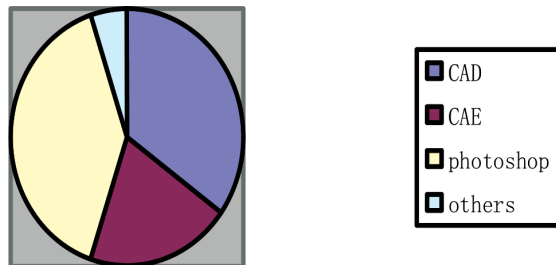


Figure 1 – Market Shares of Computer Graphics Software

2.2.Examples of Computer Graphics

Computer graphics image develops so far, it can be described as a variety of different forms. Area of computer graphics and image processing can used to do various transformations such as rotation, tilt, mirror, perspective and other. Replication and blotch removal, repair modification of image damaged. Color of the image brightness, color coded adjustment and correction, also can be in different colors to switch to meet the application of images in different areas. Computer graphics and image processing technology to express the basic purpose is very simple, it is a picture after the treatment, give people a strong visual impact, showing a vivid sense of beauty, to the people to enjoy a better visual. To achieve this goal, we need to set geometry properties, the graphics requirements of light, material, texture and so on in the model to show, in order to achieve the desired graphics requirements (Eriksson, K., 2015). Thus it can be seen that in geometry processing, the function of the computer and computer graphics has a close relationship, in a geometric model ,computer graphics can be the geometric entities of the technical processes of directional analysis, and through the digital image of the image data results also show that. Thus it can be seen, computer graphics and computer image processing technology is complementary inseparable.

With the contrast of traditional poster, most of the graphical model is simple to design, and with the development of modern science and technology, the emergence of new forms is slowly growing, graphic formation is becoming more diversified, and making graphics is no longer simply stick to the tradition, but the new technology brings more extensive changes and the graphic combination is no longer a single point, line, surface, but more vivid freely, color overlay and collocation is no longer monotonous, but more sense and sense of change, such as: new technology brings the graph more delicate, graphics beyond the traditional way before fine degree and the complexity, thus

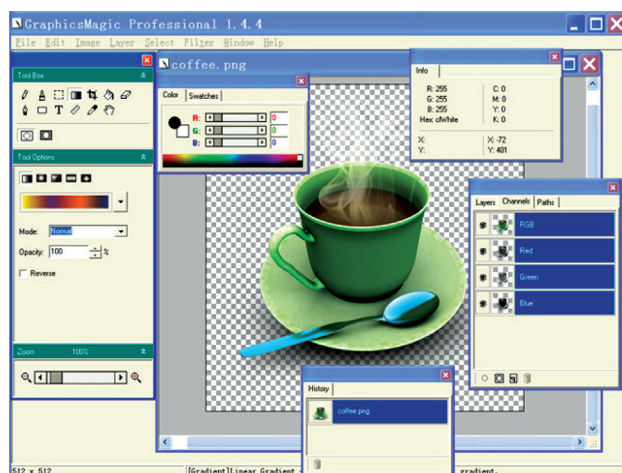


Figure 2 – Examples of Photoshop

brings a richer visual effects, the possibility of the meaning of poster has more deep development, and towards a more three-dimensional graphics transformation ,texture and other different effects are also produced more real and fine, which is a qualitative leap in graphic design (Anonas, M. R., & Alampay, L. P., 2015). The computer graphics and image technology can show the traditional painting that match the visual effect and speed, so it is of great practical significance to study the combination of the two.

3. Exploration of Software

The combination of computer graphics software and graphic design application produced a lot of similar works, breakthrough design patterns and graphics creation mode of the original, even breaking the limitations of thinking to create more changes with rich graphics, showing three-dimensional images in two-dimensional space, or two-dimensional space graphic design, cannot be completed in two-dimensional graphics base of the original creation of the human brain up, all the design elements are realized in the new media platform, not impossible, only unexpected, design is no longer restricted by some objective factors, the designer can create a graphic image by computer (Warrick, J. W., Timm, A., Swick, A., & Yin, J., 2016). These are significant with the characteristics of new media design and graphic design combined with graphic elements on some breakthrough. In the traditional hand-painted design, there are many limitations, there are a lot of color that can not be superimposed or superimposed after completely incompatible or just perfect transition exists in computer, and today, it was possible, in the design of computer application platform, in the production of software, can be superimposed any different colors, can choose any impact and penetration is not generated when make a variety of colors, each color can maintain levels, so computer graphics technology and graphic design combined with color combination also brought the breakthrough on the new media and graphic design combined with the application of the picture creation can be achieved. Also it can be used in image recognition, and with the development of science, the external interference is reduced.

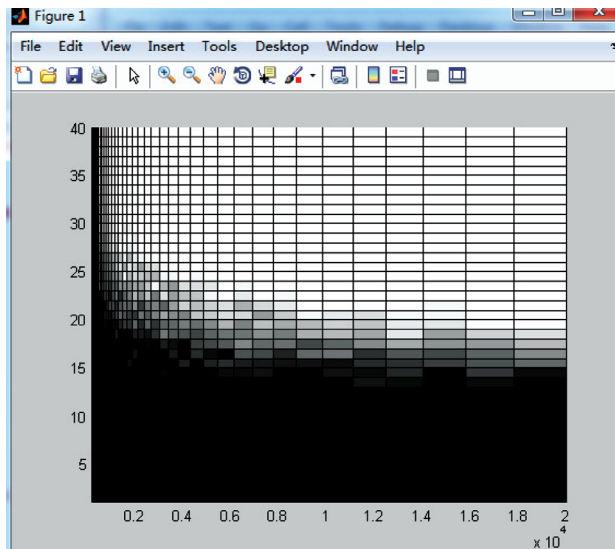


Figure 3 – The Changes of Influencing Factors in Image Recognition

With the continuous development of computer technology, many software related to computer graphics and image processing have emerged as the times require. The software can through 3D images and animations will object shape and size of the image more and more intuitive, allowing designers to more clearly understand their own design ideas, and can be modified at any time. Computer graphics and image processing technology can change the original need to design a kind of test method, by using CAE software to simulate the design of the design, reduce the cost of design (Foley, T. P., Límanová, Z., & Potluková, E., 2015). At the same time, through the CAD software design, changes the original manual drawing (Oinonen, S., Hyytiäinen, K., Ahlvik, L., Laamanen, M., Lehtoranta, V., Salojärvi, J., & Virtanen, J., 2016), 2D and 3D design organic to combine, with three-dimensional graphics so that the plane is more tension and a sense of space, which can make the picture becomes rich and is changing, on the restriction of the picture made with infinite tension of space, the picture becomes with speed, breaking the original static, this a series of change makes the whole picture has a greater impact.

In the two-dimensional space of two-dimensional picture, the design itself is also a great breakthrough, the original picture has become a dynamic effect by the designers, this is a design looks very simple, but when you stare at the screen when viewing the change in pictures, picture design is to use the the spherical shape change, bring people eyeball illusion, fluctuating picture, a layer of continuous moving down, so that the original static picture has become less stiff change (Brabcová, I., Bártlová, S., Hajduchová, H., & Tóthová, V., 2015), this is the new media and graphic design combined to bring a still picture break the normal procedure, breakthrough, add the dynamic effect in the rest of the screen, the whole design is more interesting, let the audience more impressive.

In addition, combined with the technology of computer graphics and graphic design, not only reflected in the two-dimensional space in the sense of space, three-dimensional

sense, these pictures in space have a huge breakthrough, but also in the display mode appears three-dimensional development, using the real space to display works, show a real three-dimensional space feeling (Díaz, P., Panadero, R., López, R., Cordero, A., Pérez-Creo, A., López, C. M., ... & Morrondo, P., 2016), fully combining multiple elements, the use of all can be used to assist the design elements such as: the use of sound light the interior space and other elements combined with design works to create three-dimensional new space during the show to make full use of these elements will be the audience's Visual Auditory tactile touch everything, the elements are mobilized (Brodt, G. A., Geremia, J. M., Melo, M. D. O., Vaz, M. A., & Loss, J. F., 2015), stimulated by the external environment, bring the audience a new experience of not only on the screen, but also in real space for the audience to create atmosphere, make the view All the real work is fully integrated into the design.

Computer graphics the dependence on Technology in making 3D animation art and visual effects in more obvious areas with a variety of digital technology and the join force, mechanics, bio engineering, human engineering and other disciplines, imitation acoustic support, the digital media art almost equal to anything in the image creation, 3D effects, non-linear editing, and multimedia technology etc. the new production methods and techniques, the traditional cannot create magical effects can be achieved if the Hollywood is the world's film dream factory in the editing and integration of digital computer technology, so the magic is to help those super directors dreams an indispensable tool when we have seen the animated film virtual but true to life the role of fantastic performances, or feel the universe in the wild The unknown world of magic, it will can't help for technology of computer graphics and image magic by dumping, admired. For the 2009 film Avatar to cumulative global 27 billion to \$54 million at the box office, in one fell swoop the global cinema box office records.

Due to the continuous development of new science and technology, computer technology is more and more developed, almost anything can be applied to computer software to achieve the above example, reflect a typical out now design already cannot do without computer, also cannot do without the synthesis processing software, the application of scientific and technological means to make our expression becomes more diverse, anything can be smoothly through the computer to achieve, whether it is true or false, as long as we have in mind that the inspiration and the influence of such a design, so the skilled application of computer and software, we can achieve the design we want an easy job to do, because it is clear that the design itself embodies the technique of expression more and more dependent on new technology, not high-tech assistance we can achieve some things in our minds, no new technology continues to change, we Unable to create new things, design and technology is complementary to each other, interdependence and the development and survival of the design itself is more and more dependent on the performance of the new technology.

Year	2010	2012	2014	2016
Number	1000	3407	9810	15090

Table 2 – The Numbers of 3D Companies Since 2008

According to the domestic and foreign film industry in the past 10 years, the computer image of the company's survey shows that the computer graphics software based graphic design companies continue to increase, the increase in the proportion of data.

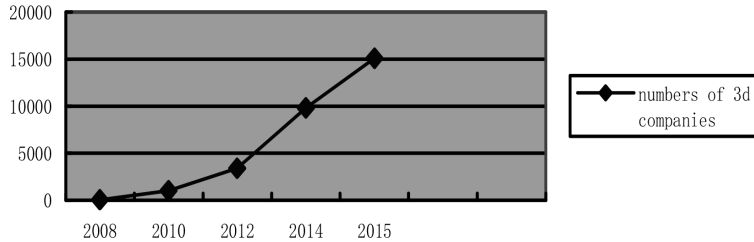


Figure 4 – Changes of Numbers of 3D Companies

4. Operation Process of Computer Graphics Software

Computer graphics image processing technology to be used in the most basic components of graphics and image processing software and computer hardware equipment. Generally speaking, the higher the performance of the computer hardware equipment, the more able to handle a number of high quality graphics, and graphics image processing software will be closely linked with the display terminal. For the commonly used in computer graphics and image processing software, due to its modification, storage, design function can the picture data quickly integrate together, thus greatly reducing the burden of operating the computer central processor, effectively improve the efficiency of software work, and ensure the images with high quality. In the process of computer graphics and image processing, the mouse and keyboard is the most commonly used input terminal, the mouse and keyboard combined together can locate and modify the picture and like printers, plotters, display belongs to an output device of the computer graphics and display system can be preserved complete picture. The earliest computer art works is implemented by computer programming language, their basis is a mathematical formula people prior simply cannot imagine what is the combination of these formulas. It is said that the earliest is spiral line digital home in very occasional use computer programming. These figures shown by the formula, the result of the marvelous structure, changing the image: let a person dazzling, ever-changing geometric lines, colorful color! Halo, as if is fantasy world. With a variety of professional graphics software development and upgrading has been by don't master the complex programming techniques can by means of intelligent software tools to generate a variety of digital graphics, fractal graphics of the supernatural and rational beauty will for more and more people recognized and accepted.

Computer graphics and image processing technology to the operation of the steps to complete the most important step by six step:

1. geometric transformation of projection, translation, scaling, rotation, etc.
2. image analysis and segmentation, digital and encoding, enhancement and restoration, etc.
3. to eliminate the hidden surface and line of computer graphics.
4. modeling of computer graphics.

5. to fit the curve of the graphic image.
6. at the end of the color design, as well as the relative brightness and texture to be processed.

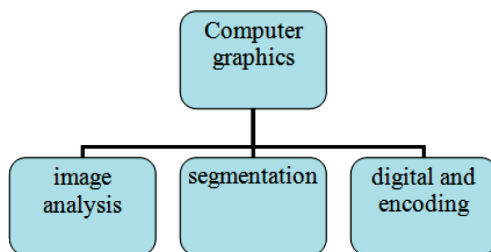


Figure 5 – The Calculation Mode of Computer Graphics

After these six steps, the geometric properties of the object will be displayed in the form of digital images, and then through the late processing such as modification, storage and so on to complete the processing of the image processing process.

By computer with digital image technology and the formation of the vector drawing is a kind of based on numerical calculation, to point, line, surface composition of rational art as an important part of CG, vector graphics with digital technology on the graphic description of the hard edge style, and is particularly suitable for logo, cartoon, the standard character and the graphic design showed a rational beauty. Compared to the traditional art of painting brush strokes of the natural random effects and the vector drawing seems to be slightly significantly blunt, but good use of the hard edge performance style and won't let a person feel cold and mechanical, now network overwhelming cartoon animation, vector illustration, flash, games and mobile phone MMS, and so on vector graphics, with their unique color and style, constitute the age of a dazzling fashion element vector graphics appearance bright, simple and gorgeous artistic style by the favor of the young generation and respected.

Because vector graph software all the graphics are composed of different shapes of geometry, and to provide a strong point line. Surface rendering tools and improve the object management technology, this technology complete, brought to the artist is graphics easy to draw and regulation, in order to make the artists in drawing creation process. It was found that the new technology of new visual elements and characteristics, original inspiration for the excitation of the creator, explore the new way of thinking, so as to create works with a new visual effect. As an important means of expression in graphic design, cartoon has been widely used in the works by many artists, and the emergence of vector graphics has injected fresh blood into the art form.

Computer graphics image post-processing and beautification of the commonly used software CAD, PS, MAX 3DS, and so on, with the continuous development of the technology, its application is also more extensive and in-depth. Mainly used in the industrial production of product design, product manufacturing, electronic circuit design, web design, advertising design, etc. The application of computer technology in the post processing and beautification of the graphics and image has greatly improved the precision and speed of the graphic image design, so that the complicated graphic design can be realized accurately and perfectly. For example, the use of the computer for the post

processing of people's photographs, artificial for the face of the skin, wrinkles, freckles and other difficult to deal with, but the computer can easily get it all. In addition, the powerful data processing function, which provides a wide range of image processing and image beautification, is conducive to the diversification and enrichment of graphics and image processing. At the same time, it can realize the storage and processing of the massive data information of the image. In short, with the continuous development of computer software and hardware, computer graphics and image processing and landscaping technology will be more excellence, and its application will be more extensive and mature.

5. Algorithm of Computer Physics of Image Processing

With the widely use of raster display, pixel level algorithm becomes a research hotspot of basic algorithms of computer graphics now. Since pixel level pixel coordinate, trigonometric function must be used to translate polar coordinates to pixel coordinate when the curve is described by polar coordinate.

Hormann Greiner algorithm uses the structure of two-way linked list, each polygon by a two-way Chain Table to express. When each node is found, it is inserted into the solid polygon and the clipping polygon. The two two-way linked list.

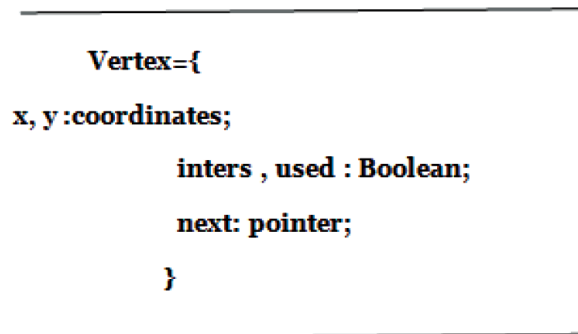


Figure 6 –Vertex Data Structure

For the general polygon window of the line, the first to be cut in line or the extension of the line to choose is fixed point. This fixed point should be left in the top left (or under the bottom) of the polygon window. Then, the slope of the line from the fixed point to the polygon is calculated. That is:

$$vs_i = \frac{y_i - Y_f}{x_i - X_f}$$

It is used to deal with the intersection of the following figure.

6. Results of Exploration

Graphics are real, and the image is controlled by people's subjective consciousness. The two items can be effectively combined by computer graphics and image processing

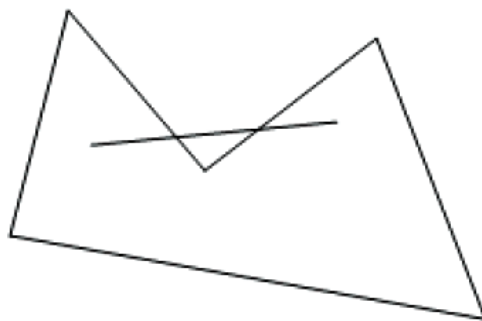


Figure 7 – Example of Intersection

technology. The continuous progress of computer graphics and image processing technology to promote the combination of these two more and more harmonious, in various related areas is playing an increasingly important role. Computer graphics and image processing technology to express the basic purpose is very simple, is a picture after the treatment, give people a strong visual impact, showing a vivid sense of beauty, give people bring good visual enjoyment. To achieve this goal, we need to set geometry properties, the graphics requirements of light, material, texture and so on in the model to show, in order to achieve the desired graphics requirements. Thus it can be seen that in geometry processing, the function of the computer and computer graphics has a close relationship, in a geometric model and computer graphics can be the geometric entities of the technical processes of directional analysis, and through the digital image of the image data results show that.

Generally speaking, after differences in image processing and the representation of reality is bigger or more special treatment, often can convey more overtones, especially low affinity material of image and image processing is particularly important. The technology of computer graphics and graphic design combined with graphic elements applied on some breakthrough, breaking the original hand-painted design graphic combination of limitations, so that any combination of graphical symbols as possible, the application of computer technology makes the new graphic style, inherited the hand-painted design works of natural feeling, at the same time as computer etc. new media, which makes the picture more rich can integrate graphic elements, we think the re combination of recreation, to create a design style, we want can make the graphics closely and full order, to the extreme complexity, these traditional graphic design cannot achieve. Only through perfect new media and graphic design combined with the most incisive performance.

Computer graphics and image post-processing is mainly through the translation, rotation, zoom and other technical operations, the overall sense of image and graphics has been optimized. At the same time, through to realize adjustment of image brightness, the color and so on, to beautify the image of the role, the graphic images show better stunning visual effects and sensory enjoy. Among them, the data and data processing is the key to the graphics and image, using the computer technology to convert the graphics image to digital conversion and restoration is the foundation of the image processing. At the late stage of computer graphics and image beautification processing

operation, first of all, requires the use of computer image and graphics data processing and rational use of storage in computer graphics, image data of graphics and image of input, edit and output, at the same time, but also with the help of related equipment for communication between designers and computer, people's thoughts and consciousness through the computer system performance out, use computer equipment to produce human can't and the image effects. Secondly, for the graphic image of the necessary technical treatment, such as translation, rotation and combined with the real model in graphic art to beautify and precision design, from the details of optimizing the image of beauty, perception. Again, combined with the use of dot, line, face, change design and color, color conversion of graphics and image were beautification, eliminate the disadvantages and defects of image and graphics, injected into the human spirit and aesthetic experience.

In real life, computer graphics and image post-processing and image beautification operation technology has been widely used, in advertising design, web design, the application of the technology completed the complex image design, such as CAD software, is widely used in industry production and advertising design industry, on the other, in people's daily life, the technology has been widely used, such as people commonly used Photoshop software for modification of the character image.

Combining with the development of application of computer graphics software and graphic design for the whole design has a great impetus, it affects the whole design from the creative, to make, to each link of release, should be more precisely described as each design field links are influenced and restricted by the calculation of machine graphics, but also by the influence of new science and technology, combined with the application of new media and graphic design not only in the design ideas, the designers have produced a huge change, and create a more varied design form more, in the new technology, in every step of the update, the design tends to become more humane, according to the characteristics of significant computer graphics and graphic design from the graphics creation view is breaking the shackles of traditional graphics, combined with the application of new computer technology to create a new Graphic image more features more tension, break the original static, flat screen, the figure has a dynamic tension!! and has a three-dimensional sense of space, so that a simple graph becomes more full of vitality, continuity is more complex, in the degree of graphics and accuracy, have significant features combined with computer graphics, beyond the original Handmade roughness, so that every detail is very detailed, even the computer can create people through the image hand through the naked eye cannot create; in color, in the computer of the new media in the presence of color to break the routine, we can make the impossible to implement manually graded color, color transition and color is covered by the effect of many things we can not direct manual modulation of the color in the computer with the help of It can be easily realized by numerical calculation, so that we can enrich the color richness of the design works.

7. Conclusions

Computer graphics and image in the graphic design process is a more developed idea, more rapid, more realistic simulation, more mature and more effective storage, it breaks through many previous in the creative arts, creative methods and creative aspects of

restrictions, the artists and designers in the new world of creativity, at the same time. Image and artistic status and future are also facing the scientific. Humanities and its challenges impact people to engage in computer graphics images, it is not only an opportunity, but also a challenge. In a word, the graphic image is the most intuitive way for people to communicate, and the technology of computer graphics and image processing, for people who want to express emotion more convenience. Expression is personal understanding of the image and the use of computer hardware and software is a better and skillful way, research on computer graphics are used to promote the common development of graphic design.

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Research on Temperature Control System of Baby Bath Center Based on Fuzzy PID Control

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Abstract: Objective: Because the baby's body temperature regulation center is not perfect, therefore, the bath water temperature is too high or too low will cause adverse effect to the baby, generally requires the water temperature control in a certain range. If the use of external shower water is easy to affect the water temperature. Fuzzy control and PID is used to control the temperature control system, which can satisfy the requirement of dynamic performance and the steady error of the system. In this paper, a specific implementation scheme of temperature control system for baby bath center based on fuzzy PID temperature control is proposed in this paper.

Keywords: Fuzzy control; PID; infant; temperature control.

1. Introduction

Baby bath every day, can clean and protect their skin, promote blood circulation, increase body resistance. And baby shower cannot stand with adults as well as the use of a shower or the use of family common bath. In general, the newborn baby bath must use special baby bath. When the baby shower, suitable temperature placed in certain depth in the baby bath water, then put the baby into the water (Wittrahm, A., 2015; Ntshongwana, P., Wright, G., Barnes, H., & Noble, M., 2015; Garcia, J., 2016).

Because the baby's body temperature regulation center is not perfect, therefore, the bath water temperature is too high or too low will cause adverse effect to the baby, the general requirements for water temperature control at 36 to 39. If the use of external shower water is easy to affect the water temperature. If you simply use a bath towel to the baby water above the surface of the insulation, in the cooler weather, the insulation effect is not ideal. If using ordinary water containers from the tub water kept pouring water, you will need to increase manpower, more complicated (Isupova, O. G., 2015; Bogue, B. Z., 2015; Muzaffar, N., 2016).

PID control has the advantages of simple structure, high reliability, easy to implement, and can eliminate the stability error, etc... But the traditional application of temperature control system has the characteristics of large inertia, long delay, and so on. When using the traditional PID control, the controlled object dynamic and static characteristics

cannot reach the requirements of the application. Fuzzy control and PID is used to control the temperature control system, which can satisfy the requirement of dynamic performance and the steady error of the system (Endress, T., & Gear, T., 2015; Soda, J., Vujovic, I., & Matic, P., 2015).

In this paper, the temperature control system of the baby bath center is designed and simulated by using the fuzzy PID theory (Carvalho, A. A., Araújo, I., & Fonseca, A., 2015).

2. Control System Strategy

2.1. Control Principle

The overall distribution diagram of the design is shown in Figure 1:

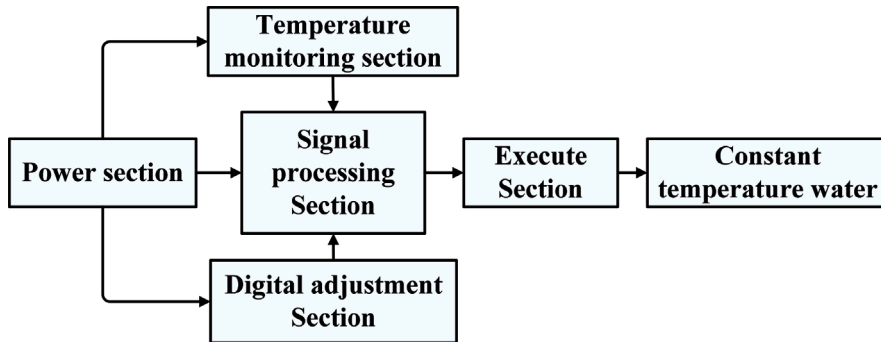


Figure 1 – The Distribution of the Whole Design Relations

PID control is one of the most commonly used control methods in the process of temperature control. Principle as shown in Fig.2.

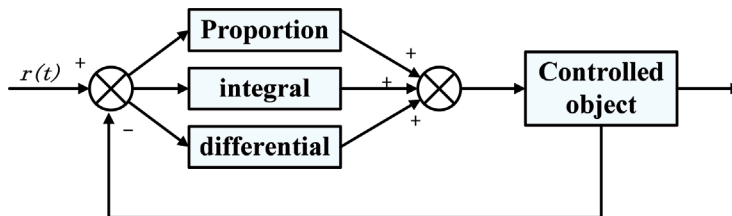


Figure 2 – PID Control Diagram

The transfer function of the PID controller is:

$$G_c(s) = K_p \left(1 + \frac{1}{T_i s} + T_d s \right) \quad (1)$$

The relationship between the input signal and the output signal of the PID controller is:

$$u(t) = K_p(e(t) + \frac{1}{T_i} \int_0^t e(t) dt + T_d \frac{de}{dt}) \quad (2)$$

In those formulas, $u(t)$ and $e(t)$ is output and input bias signal; K_p is proportional coefficient; T_i and T_d is an integral differential time constant.

2.2. Fuzzy Control

Fuzzy control is based on fuzzy set, fuzzy linguistic variable and fuzzy inference theory, which can imitate the part of the brain in a certain degree, and it can make effective decision and reasoning for the controlled system. The measurement value of the sensor input, (Nishiyama, K., Nakashima, H., Yoshida, T., Ono, T., Shimizu, H., Miyasaka, J., & Ohdoi, K., 2016) and the given value of the error signal, after the A/D converter to get the input of the controller, the first need to be fuzzy processing, the obtained fuzzy quantity into the reasoning machine, according to the pre prepared fuzzy control rule table, the output of fuzzy control is needed in the D/A converter, output to the implementation of the system control, fuzzy control is shown in Fig.3 (Rao, G. P., 2015).

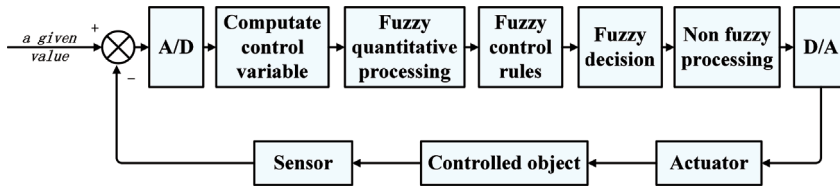


Figure 3 – Block Diagram of Fuzzy Control

2.3. Adaptive Fuzzy PID Control

Adaptive fuzzy PID control is a control method that we used to adopt. It uses the structure of the two dimensional fuzzy controller, the error e and error change rate ec as the input variables. According to the two parameters, the three parameters of PID (K_p , K_i and K_d) are modified by using fuzzy control rule table. The output variables are added to the PID controller, and the three parameters are adjusted online (Sudha, G., & Deepa, S. N., 2016; Prasad, B., & Reddy, S. M., 2015).

Adaptive fuzzy PID controller structure is shown in Fig.4.

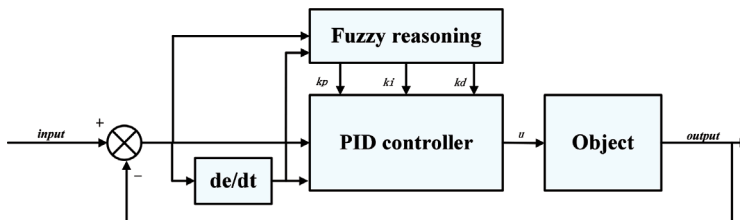


Figure 4 – Adaptive Fuzzy PID Controller Structure

3. System Design and Implementation

3.1. Controller Design

3.1.1. Fuzzy PID Control Variable Determination

The two dimensional fuzzy controller adjusts the parameters K_i , K_d and K_p under the input variable e and the deviation change rate ec . The input variables e and ec are {NB, NS, NM, ZO, PS, PM, PB}, {-3, -2, -1, 0, 1, 2, 3}; the fuzzy subsets and the domains of K_d , K_i and K_p are {Z, S, M, B}, {0, 1, 2, 3}; Their fuzzy membership functions are chosen as the triangular membership function.

3.1.2. Fuzzy PID Control Rules

The characteristics of the mathematical model of the controlled object, and the fuzzy control rules are obtained in the following tables from the variation of the parameters under different bias e and variation rate ec of K_i , K_d and K_p .

E	EC						
	NB	NM	NS	ZO	PS	PM	PB
NB	M	S	M	M	M	S	M
NM	B	M	B	B	B	M	S
NS	B	M	B	B	B	M	S
ZO	B	M	B	Z	B	M	S
PS	B	M	B	B	B	M	S
PM	B	M	B	B	B	M	S
PB	M	S	M	M	M	S	M

Table 1 – K_p 'S Fuzzy Control Rule Table

E	EC						
	NB	NM	NS	ZO	PS	PM	PB
NB	Z	S	M	B	M	S	Z
NM	Z	S	B	B	B	S	Z
NS	Z	Z	B	B	B	Z	Z
ZO	Z	Z	B	B	B	Z	Z
PS	Z	Z	B	B	B	Z	Z
PM	Z	S	B	B	B	Z	Z
PB	Z	S	M	B	M	S	Z

Table 2 – K_i 'S Fuzzy Control Rule Table

Then press if. Then In the form of 49 fuzzy control rules, the design of the fuzzy rules into the MATLAB fuzzy toolbox, the formation of the FIS file, so that the simulation time call.

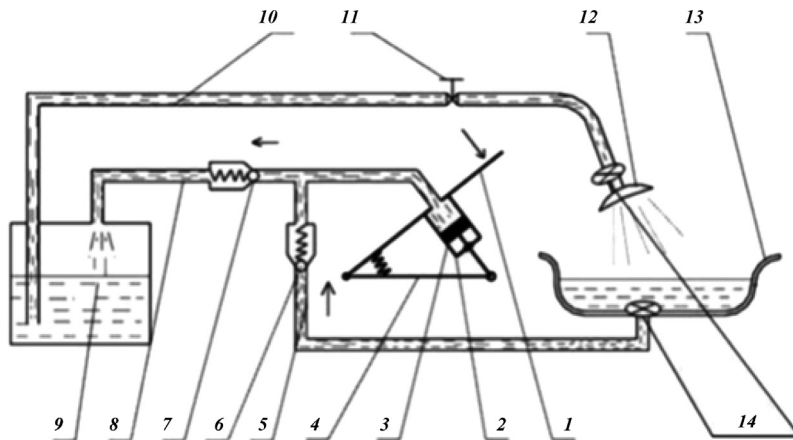
E	EC						
	NB	NM	NS	ZO	PS	PM	PB
NB	S	B	B	S	S	B	B
NM	S	S	M	M	Z	S	S
NS	S	Z	Z	S	M	Z	S
ZO	B	B	S	S	S	S	Z
PS	Z	S	M	Z	S	S	S
PM	S	S	S	S	S	M	S
PB	B	B	S	S	B	B	S

Table 3 – K_d'S Fuzzy Control Rule Table

3.2. Automatic Circulation Water Baby Bath Design

3.2.1. Principle Design of Automatic Circulating Water Shower

As shown in Figure 5, automatic circulation water baby bathtub by a foot pedal, piston cylinder, piston rod, resilient frame mechanism, water pipe, water valve, water pressure check valve, pressure water pipe, water outlet pipe, temporary storage room, switch, shower and filter baby bath etc.. When in use, the 13 baby bath into the amount of warm water, by foot, foot pedal 1, 3 so that the piston moves upward, piston cylinder 2 cylinder piston side volume decreases, at the same time, the water pressure check valve 7 on the right side of the increasing pressure until the open water pressure check valve 7, 2 gas and water pressure pipeline 8 in the piston cylinder is pressed into the temporary storage of water room 9. Then when my feet, because of the role of elasticity, rebound spring rod rack mechanism 4 in the piston cylinder piston return, the volume of the piston side cylinder 2 increases, the air pressure decreases, the water pressure check valve 7 closed suction one-way valve 6 open, 13 of the water in the baby bath by the filtering device 14 after filtering, in under the action of atmospheric pressure through the suction pipe 5 is pressed into the piston cylinder 2. (Inkkaar, R., 2015) Continue to foot the foot pedal is 1, water 6 one-way valve closed, the water pressure check valve 7 is opened, the piston cylinder 2 in water is pressed into the temporary storage of water in room 9. So reciprocating dozen times, the temporary storage of water in the air chamber 9 of the water continues to increase. Since the temporary storage chamber 9 is closed, the air volume in the air chamber is compressed and the pressure is increasing. Therefore, there is a certain volume of water and high pressure air in the temporary storage chamber 9. When open shower nozzle valve switch 11, temporary storage of water in the air chamber 9 of the water in the role of high pressure air filter 14 filter, from the shower nozzle 12, to achieve the baby shower, until the temporary storage of water is completely discharged 9. (IKEDA, Y., KIDA, T., & NAGASHIO, T., 2016) Through the reasonable selection of the piston cylinder and temporary storage of gas chamber volume, and adjust the switch output water of suitable size, can be achieved when the foot less time, the function can be sprayed with a longer time (Patil, L. G., & Prajapati, R., 2015).



1-foot pedal; 2-piston cylinder; 3-piston; 4-resilient bar frame mechanism; 5-suction pipe; 6-suction check valve; 7-pressure water check valve; 8-pressure water pipeline; 9-temporary storage chamber; 10-outlet pipe; 11-switch; 12-shower nozzle; 13-baby bath; 14-filter.

Figure 5 – Schematic Diagram of the Principle of Automatic Circulation Water Baby Bath

3.2.2. Design of Temperature Control System

In order to ensure the temperature of baby bath can be maintained at between 36 and 39 degrees Celsius, the use of fuzzy PID controller to increase the temperature control function. As shown in Figure 2, when the thermistor temperature probe measured water temperature feedback to the MCU fuzzy PID controller in the resistance changes, processing temperature data will be collected from the MCU control relay, heating or disconnect. The water temperature of the water flowing through the heating pipe can be increased by 1-3, and the water temperature is kept at 36 to 39 degrees Celsius.

In order to ensure the safety and reliability of the temperature control, the PTC heater is used in this design. PTC heaters are widely used in electric appliances, foot bath and other industries, with real hydropower separation, environmental protection and other safety features. Secondly, in order to prevent users from negligence, water and other causes of dry heat, in the PTC heating tube outer wall insulation tape after high temperature resistance to heat protective device 1 (action temperature 85 C), when the dry heat, due to the water through the pipe, so the thermal resistance probe will not work, heating pipe temperature rise sharply, the main circuit, the protection of the whole system. Third, in order to further ensure the safety, the last section of the nozzle of the outer wall of the pipe insulation, and the other is fit for the heat of the 2, the action temperature value 45. The device can be in the case of the controller or relay failure, as long as the water temperature is higher than 45, the main circuit is immediately cut off, and the display is no longer displayed, warning users to take measures to ensure safety.

4. Simulation Experiments and Analysis

The dynamic characteristic of the controlled object is compared with the dynamic characteristic of the controller, and the step response curve is observed by means of

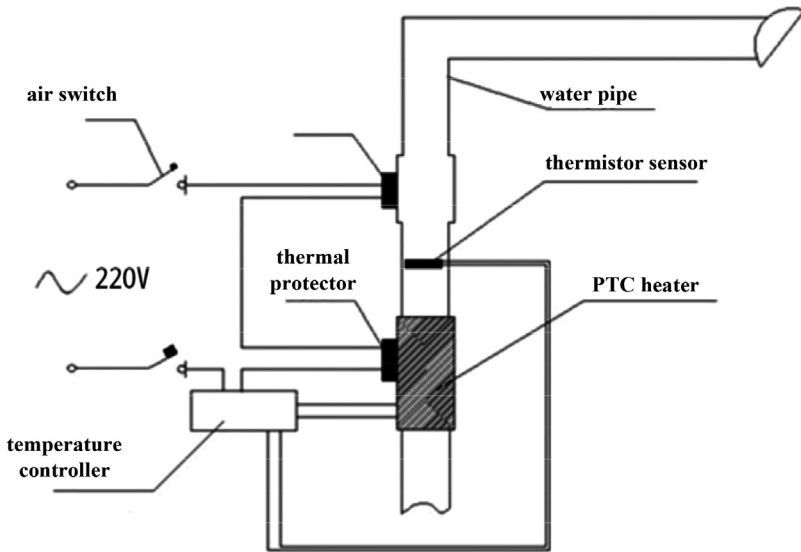


Figure 6 – Schematic Diagram of Constant Temperature System Module

the oscilloscope. Through the experimental data and drawing method, the temperature control system is simulated by using the transfer function below. The simulation results in Simulink are shown in Fig.7.

$$G(s) = \frac{K \cdot e^{-\tau s}}{Ts + 1} \quad (3)$$

$$k = 3.75, T = 420s, \tau = 90$$

Step signal control system with dynamic performance simulation, the simulation results are shown in Fig.7, the curve in the figure dotted and solid lines said in response to join the ideal PID and fuzzy PID controller respectively, obviously we can see that the fuzzy PID controller system rise time decreases, the stability time increased, significantly improve the system with dynamic characteristics.

The anti-disturbance characteristic of the controller is applied to the controlled object, and the response curve is observed. The simulation block diagram is based on the dynamic characteristic simulation and adds the noise jamming module and the input is changed to a constant value signal.

Simulation results are shown in Fig.8.

Figure line represents the ideal and fuzzy PID anti-jamming effect respectively, after adding the fuzzy PID controller can improve the anti-disturbance performance.

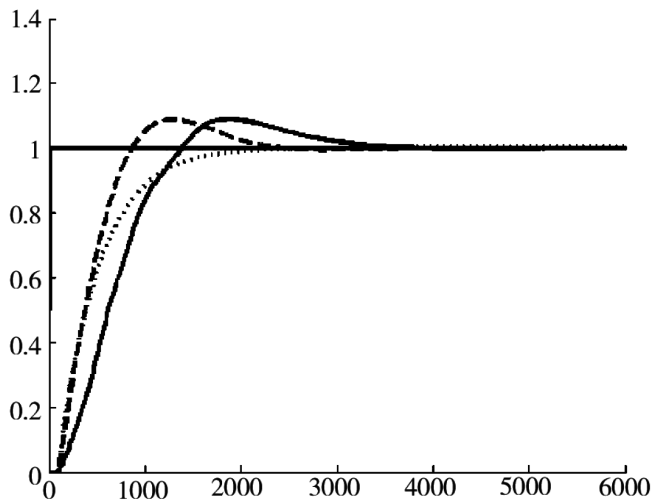


Figure 7 – With the Dynamic Simulation Results

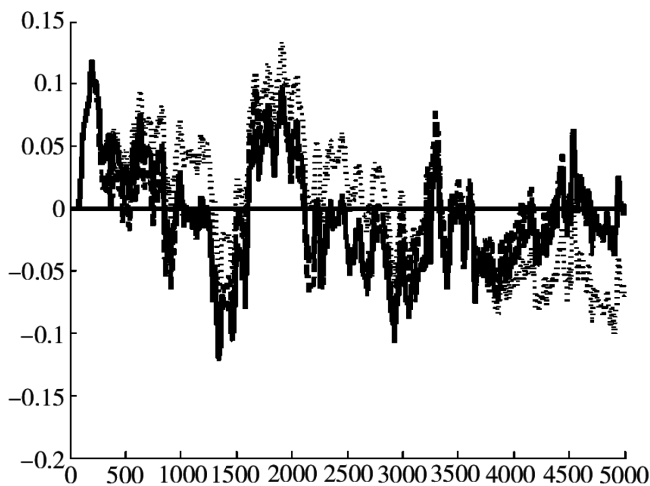


Figure 8 – Anti-Disturbance Simulation R5result Graph

5. Conclusions

According to the analysis of the current in the family to the newborn baby bath process, infants exposed in the temperature above the water surface area, water temperature easy to cold tub will continue to reduce the shortage, designed by using the pedal mechanism, hydraulic transmission and control system and temperature control system for automatic cycle leaching the water baby bathtub, put warm water from the baby in the bathtub pedal water, automatic water, without adding water to the tub, baby out of the water body has

better heat preservation effect, and then through the fuzzy PID control system can control the water temperature, water temperature between 36 and 39 degrees Celsius, ensure that the baby has a bath water temperature appropriate. Automatic circulation water baby bathtub is safe, economic, practical and other advantages, has a good market prospect.

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Based on Mobile Agent Data Acquisition of Mobile Campus Network Construction

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Abstract: The construction of campus informatization level and, it is to measure the management level of the school, scientific research and application of an important index of comprehensive ability. Now, with the improvement of science and technology, science and technology personnel to establish the ideas of mobile agent, and through calculation procedures, the use of mobile Internet technology, the smart phone, Pad, such as mobile terminals as application service carrier, construct a with teaching, scientific research, management and campus life as a new type of intelligent platform, namely mobile campus network. In view of the university colleges campus information portal and other scattered, establish a comprehensive information service platform; Achieve personalized information push for individual or group, for different scheduling request to push model, the guaranteed to push information to the client in a timely and effective manner, reducing network connection time to achieve the power loss and the optimal control of network traffic.

Keywords: Mobile agents and mobile campus; mobile terminals; information transfer.

1. Introduction

With the development of computer network technology and the wide application of network can let the agent in the network of mobile and complete a task, it is the thought of "mobile agent". Mobile agent thought is put forward, in order to solve the WWW information service in the network transmission and search problem provides a new way, make the agent has the characteristics of the distributed computing technology, further extend the functionality of the agent to handle affairs. Mobile agent can independently on heterogeneous networks, in accordance with the prescribed route.

Still, looking for the right computational resources, information resources and software resources. With these resources together in one host and network advantages, processing and use of these resources, on behalf of the user to complete a specific task.

Mobile agent is a computer program, it can move in a wide area network (e.g., www), and the external host interaction, for its own host to collect information, to complete its return to after the tasks assigned by the user. Mobile agent can complete from booking

a flight to manage telecommunications network, such as a variety of tasks .Mobile agent has the autonomy and cooperation with each other. For example, through an agent to the internal object location and communication method tell other agent, can complete the task of cooperation and communication between. In this way, agent data or information can be exchanged with other agent, and not all the information to tell other agent (Carvalho, A. A., Araújo, I., & Fonseca, A., 2015).

“Mobile campus”, refers to the use of computer networks and mobile communication technology to build information platform for mobile communications, from teaching environment, teaching resources and teaching activities on the campus space and time dimension of reality of the virtual campus. With the rapid development of mobile communication technology, the Open University learners to a growing demand for this mobile learning and mobile services, “mobile campus” as the mobile learning and mobile services platforms, the exploration and study a subject faced by the Open University.

In view of the traditional digital campus system resource utilization is low, the lack of individualized information service, puts forward a kind of wisdom campus platform construction scheme based on the mobile Internet. Crawl campus information through the network and mobile communication technology, achieve real-time access to information; Using mobile push technology, for different scheduling request to push model, provide personalized information service. Practical application showed that the mobile platform can work for the school campus wisdom to provide comprehensive, effective and intelligent management and service process.

According to the paper, “intelligent campus based on the technology of Internet of things application feasibility study” (Zhang, Z., Zhang, W., Zeadally, S., Wang, Y., & Liu, Y., 2015), the important characteristics of the Internet of things technology is a powerful perception, through radio frequency (rf) technology, laser, infrared, images, such as ultrasonic sensors, to access the Internet of things, to conduct a comprehensive perception, access to information, so as to provide a basis for the intelligent management of the campus. At the same time, due to the wired network, wireless network throughout every corner of the campus, for terminal equipment management and maintenance work will no longer restricted by time and place, the staff can be anywhere within the campus on terminal equipment management and maintenance, carry on the processing of the collected information processing. As teachers, students, and the application of the Internet of things technology will provide more quality services. In the classroom, the lighting system can automatically adjust the lamp brightness, air-conditioning system can automatically adjust the room temperature; the bathroom, the water temperature can automatically adjust according to the season, the weather, the outside air temperature.

“Based on the Internet of things intelligent digital campus research and design” (Chai, G., Lin, C., Lin, Z., & Fu, M., 2016), On the analysis of the era of Internet of things intelligent digital campus, on the basis of actual demand, designed based on the Internet of things of intelligent architecture and function module of digital campus system, studies the key technology such as RFID sensor EPC coding technology. Intelligent digital campus based on Internet of things can realize automatic identity recognition, library management, multimedia classroom and laboratory management, management of campus consumption, etc., for the teachers and students work study and daily life to provide more efficient service.

“Design and development of mobile virtual campus system” (Trigui, E., Esseghir, M., & Boulahia, L. M., 2015): based on J2ME mobile phone development technology for mobile virtual campus construction are discussed in this paper and the research, through 3 on3dmax, Photoshop, such as the development of software for mobile virtual campus, the school admissions, publicity, planning, construction and management to provide a convenient reference 3 d visualization.

“Intelligent campus monitoring system based on embedded Internet” (Park, H. S., Cho, H., & Kim, H. S., 2016):Design an intelligent campus security monitoring system based on embedded Internet a plan, and discussed the technology of embedded Internet connectivity an access method, using a dedicated chip SX. Use the network for remote monitoring, for campus security provides a convenient and reliable means of monitoring.

“Floyd algorithm in the application of the campus information intelligent query system” (Mwinyi, A. K., AL-Haddad, S. A. R., Hashim, S. J., Abdullah, R., & Aldibayeva, L., 2015):This article from the campus information intelligent query system in the light of the demand of the project for Floyd algorithm applied research, has solved the campus to solve the problem of the shortest path between each pair of information and information query, provides the digitalization and informationization of the university campus security reliable algorithm.

“Intelligent digital campus system based on Internet of things” (Sivagami, R., & Sathya, D., 2015):To solve the problem of resource integration and sharing of campus exist difficulties and the low efficiency of management problems, based on the analysis of intelligent digital campus, on the basis of actual demand, designed based on the Internet of things of intelligent architecture and function module of digital campus system, and realize the function of parts, namely, to realize automatic identity recognition, library management, consumption management, multimedia classroom and laboratory management and school for teachers and students work, study and daily life to provide more efficient service.

“Analysis and research of university digital campus system” (Lakshmi, P., & Geetha, D., 2015):With the rapid development of computer technology and network technology, the construction of digital campus network become an important task for colleges and universities. In the software on the basis of digital campus further excavation depth, extending scope, research the concept of digital campus, function modules and the possible problems in the process of construction, to achieve comprehensive informatization of education process, so as to improve the management level and efficiency purposes.

2. Mobile Agent

2.1. Overview

Since the 1990s, with the vigorous development of the global communications network and Internet, and gradually mature network technology, Distributed Computing systems (Distributed Computing System) has become a key mainstream technology in the field of computer science and a kind of important calculation model. With the deepening of the

application, distributed system has become increasingly complex and huge, put forward a reasonable abstract conceptual model to describe distributed computing system application for calculation of entities in the design and implementation is extremely important. So people introduced the concept of Agent (Agent). A software Agent can be defined as an interaction with the environment and to react to autonomous software entities, its main features include autonomy, interactivity and reactivity.

Mobile Agent (Mobile Agent) as a special Agent, as a new kind of distributed computing mode, has wide attention and research (Ghosh, G. C., Jahan, S., Chakraborty, B., & Akter, A., 2015). In the mobile Agent calculation mode, the Agent in the network autonomous mobile and operation to complete the task, and make the most of the interaction in the local. Widespread hope to calculation model with the help of a mobile agent platform from LAN distributed applications to large-scale, scale) of the transfer of network computing platform.

As shown in figure 1, a mobile agent is an active, independent entity, can from a machine in the heterogeneous network move to another to perform on stage. According to describe the concept of Agent, a mobile Agent should at least include autonomy, interactivity, reactivity and mobility of these features. Autonomy that agent cannot run independently by external direct intervention; Interactivity to and including people, equipment, and other agents to communicate with the entity; Reactivity to make timely response to changes in the environment; Mobility makes intelligence at runtime implementation independent migration on the heterogeneous network. Figure 2 shows the mobile agent's life cycle.

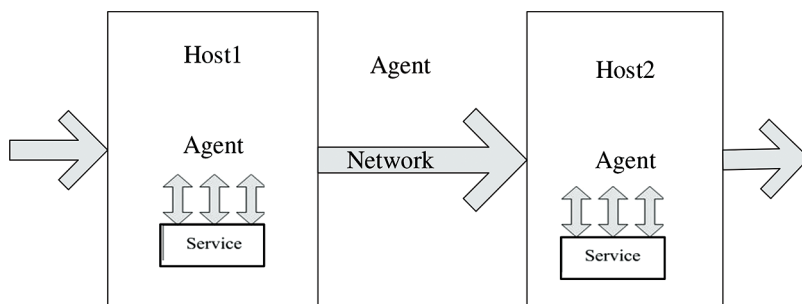


Figure 1 – The Calculation Mode of Mobile Agent

2.2. Mobile Agent Technology

Below to a mobile agent operating environment Telescript, for example,, Telescript consists of General Magic company (Mountain View, CA) to develop a mobile agent system, is a remote object oriented programming language, can be used for the development of distributed application. System development environment including engine, browsers, and managers, the debugger and related library, etc. System applications include intelligent body, which work in the location (place), engine (engine) and computer space composed of region (region), etc. The highest class is process of Telescript object level. Telescript engine is a multitasking interpreter, it can run any more programs, and to switch between them.

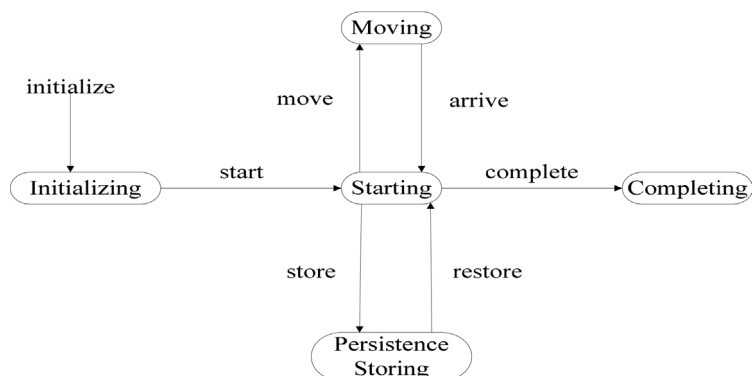


Figure 2 – Mobile Agent's Life Cycle

Mobile agent technology has three main parts: location for the agent and used in the programming language: for this kind of language design of the engine or the interpreter; Engine on different computers exchange agent required communication protocol. Below we will detailed analysis of the three parts, respectively.

First, we analyze mobile intelligent body language. Programming language C or C++. Tele script technical support. All applications can use Tele script language to write, but part of the typical application is written in C language. Agent is written in a Tele script language and location. Application language as communication, Tele script language has integrity, object-oriented, dynamic, mobility, security, and communication of concentration. (JIANG, D., & OMOTE, K., 2016).

Secondly, for mobile agent engine, we can come to a conclusion. On the user's computer engine can accommodate multiple locations and agent, on the server engine can accommodate thousands of sites and agent. Engine by storage API, transport API and external application API three application interfaces (APIs) to exploit the resources of its host. Fixed memory access fixed memory storage API to make engine, ensure the computer failure, and still can save place and agent: transport API engine access communication media, communication media is necessary for engine shipping agent to other engine: external application API allows part written in Tele script language application can connect with the C program.

The last and most important, we need to set the communication protocol. Tele script group agreement between the two engines can communicate with each other. Engine in order to shipping agent, is the purpose of the communication between to complete the "go" instruction, protocol suite can be performed on a variety of network. Such as the Internet based on TCP/IP protocol network: telephone company x. 25 interface or E-mail, etc. Tele script deal work on two levels, low-level protocol is responsible for the shipping agent: high-level protocol is responsible for the agent's encoding and decoding, which correspond to express and the application layer of the OSI model.

2.3. The Characteristics of Mobile Agent

Mobile agent is the main feature: an agent is not fixed. In many applications, the use of intelligent mobile agent instead of a static body, can produce a lot of benefits. This does

not mean that can't work without mobile agent, but only using the static agent we will pay a greater price. Through the contrastive analysis of table 1, we can see that mobile agent has the following main features: motor performance, asynchronous, heterogeneous computing, reduce the communication cost, easy coordination, flexible distribution and the structure of parallel computing, and intelligent routing. (Jhansi, S., & Sekhar, C., 2015).

	Scope of the query	Take up the space	speed	The user experience
<i>Mobile agent</i>	object-oriented	A few K bytes space	fast	Time is short, less cost
<i>Static agent</i>	Contains all the information that object	A lot of byte space	Blocking network, slow	Take up a lot of time, to pay more cost

Table 1 – The Intelligent Mobile Agent and Static Body

2.4. The Application of Mobile Agent

Mobile agent technology is a new technology, although it is put forward and the development time is short, but it brought to the attention of the many research institutions.(Habaebi, M. H., Ali, M. M., Hassan, M. M., Shoib, M. S., Zahrudin, A. A., Kamarulzaman, A. A. & Islam, M. R., 2015) Especially the emergence of cross-platform language in Java, makes the study of mobile agent technology has improved, and has successfully developed some application systems.

Mobile agent is the first commercial application of Sony's Magic Link PDA and personal smart communicators. They manage the user's E-mail, fax, phone, pager, and users can be connected to a Tele script based on information communication services, can transmit text, images, and sounds. Other application of mobile Agent technology and Dartmouth College Agent TCL system, Toshiba Plangent system, Mitsubishi Electric Corporation of Concordia system, General Mafic Odyssey systems, Germany's Goethe university Ryman system, Project at the university of Stuttgart, Germany Mole mobile Agent system, etc.

3. Mobile Campus

3.1. The Concept

Refers to the mobile campus based on campus network with mobile communication network, the school original information subsystem is effective in the transformation of the service function, and use has the construction of the campus data center, with mobile phone for mobile terminals for college students to provide a comprehensive range of services and management. Mobile service function of campus including from eating to class, to get to the hotel, all social learning life entertainment, report from school to school campus in the whole process of the employment service platform structures, in order to improve the campus management and service level, to achieve "one person one, walk through the campus" convenient, one-stop, all-round, personalized service management concept, active modern colleges and universities. Mobile campus to give full play to its carrying mobile phones for mobile terminal characteristics, to a certain

extent, breakthrough the limitation of the temporal and geographical, really any time, any place. The image of the figure 3 shows the mobile campus network application in campus life.

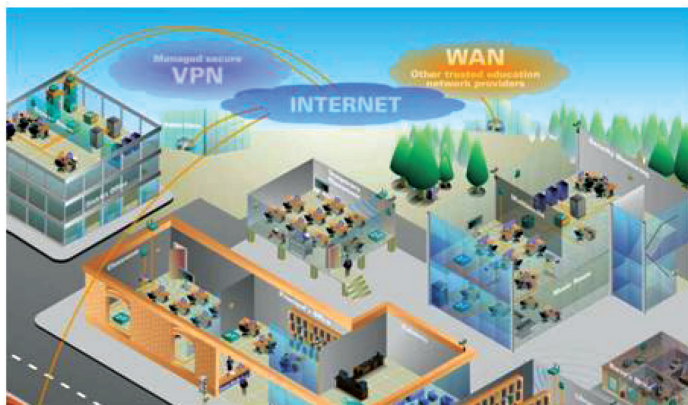


Figure 3 – Mobile Campus Network Campus Life

3.2. The Function

Mobile platform based on the informatization construction of digital campus, campus school rich academic resources, innovative teaching ideas and daily learning, teaching and life, remote education, resource sharing, information interaction, the wireless access, the latest achievements in the development of information technology such as mobile terminal, in the school teaching idea and the informationization development thought under the unified guidance of mobile display. School teaching, scientific research, management and so on each work of fully developed, and the formation of diversified information service environment, culture and wisdom. Strong support school, nice and fast development, improve the teaching quality and work efficiency. To realize the campus information, personal information query, card business, the public information services, location services, and a series of campus life required functionality. As shown in figure 4, clear and detailed introduction to the mobile application function of the campus network planning. (Poongodi, M., Bose, S., & Ganeshkumar, N., 2015).

3.3. Advantage

First of all, the extension of traditional business functions of campus network. Realize the integration of mobile payment, balance inquiries, campus identification, etc., provide convenient campus internal service for teachers and students, and expand the business functions of digital campus.

Second, promote the hit rate and utilization rate of resources of colleges and universities. The mobile campus of colleges and universities, to promote students to study independently using mobile terminals, can also convenient teacher resources retrieval, improve the hit rate of school resources and utilization.

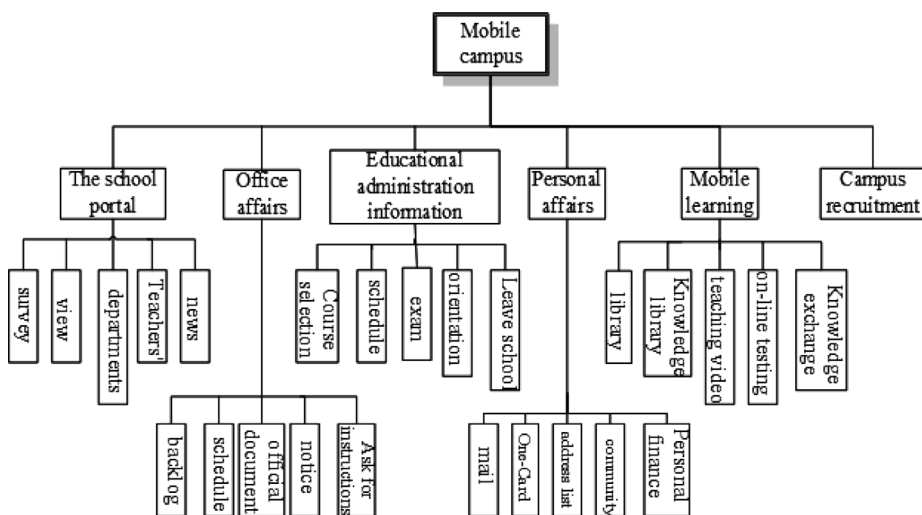


Figure 4 – Mobile Application Function of the Campus Network Planning

Then, break through the limit of space and time. School teachers and students can use mobile terminals such as smart phone, Pad on campus and off easy access to the mobile campus in resources, is no longer restricted by time and place.

At last, the personalized information service. Mobile campus to campus anytime anywhere the user personality to push the latest announcement in campus, campus information, at the same time, teachers and students also can real-time dynamic focus on his latest work and learning, to realize the personalized information push.

3.4. Construction of Points

Standards for mobile data access technology application system, through the data bridge, service scheduling and information to subscribe to a variety of ways, such as convenient different development company and technical framework of business application system flexible, convenient and timely access to the mobile campus platform, realize the mobile application and the real application of data between push and information interaction.

For school leaders, teachers, students, parents, the actual needs of the public, such as the school union role, unified identity authentication and access management, rational planning of mobile information content. According to mobile phones, tablets and other mobile terminal hardware technical characteristics and parameters, custom client, WAP and WEB site, to ensure that users get the best experience and interaction effect.

Strengthen the mobile application function, the user mobile devices such as mobile phone complete works remind, transaction handling, information management and the IC card management; Improve the function of mobile learning, the user use the fragment time access to information, watching video and courseware, finish the homework and test; Introduced a concept of community, the formation between the mobile terminal

users to work, study, entertainment, scientific research, life as the theme of “group”, mutual communication cooperation and common progress.

3.5. The Feasibility

The rapid development of communication technology, the present situation of the information construction of colleges and universities, and mobile network/Internet/ network three nets for mobile campus construction provides the technical feasibility. At the same time, colleges and universities in policy propaganda, management of daily affairs, and social communication and cultural exchange and improve the management efficiency, reduce the management cost and so on the demand for mobile campus construction provides the feasibility of management. (Deepa, A. J., & Kavitha, V., 2015).

4. The Application of Mobile Agent in the Mobile Campus

Based on mobile agent of the construction of the mobile is a campus network management, sharing, classification, query and use all kinds of campus information resources and network information resource management platform, is a system. It USES modern computer, communications, multimedia, software technology, through the resources selection, classification, audit procedures to open, authorization, enables everybody to have suitable for their own boutique repository. Figure 5 shows the people obtain information through the system of the overall process.

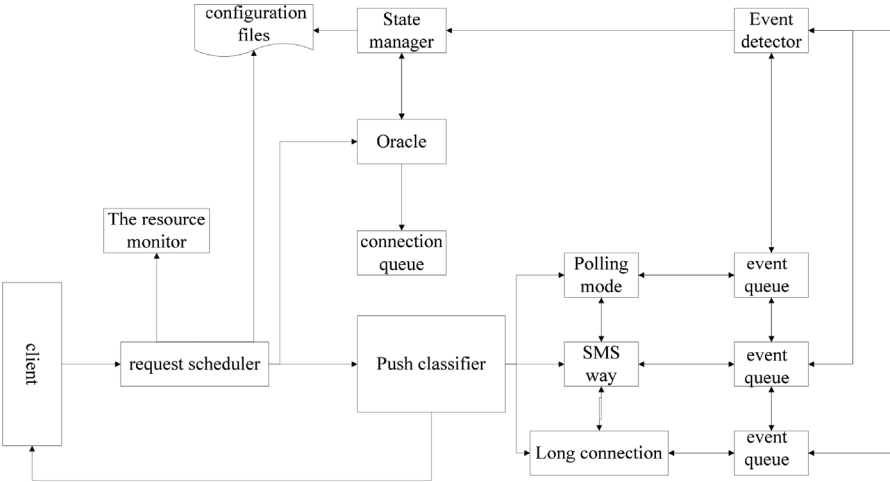


Figure 5 – Plan the Overall Process of the Campus Information Push

4.1. Algorithm of Information Query System

In this information query system, for example, briefly explain how to use the Floyd algorithm implementation.

Optimal problem can be abstracted as the following models, for solving the shortest distance between any two points:

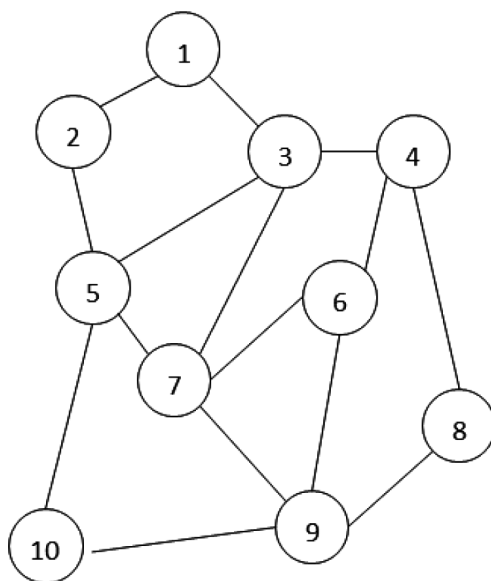


Figure 6 – Floyd Algorithm Implementation

Algorithm is a kind of used to find the given weighted graph between the vertices in the shortest path algorithm. Its basic idea is: first, establish shown below weighted adjacency matrix A , and then from the beginning of the weighted adjacency matrix $A = [a(i,j)]_{m \times n}$ $[A=[a(i,j)]m \times n$, the recursive update for n times, namely by the matrix $D(0) = A$, according to A formula, constructs the matrix $D(1)$; Again with the same formula is constructed by $D(1)$ to $D(2)$, and so on, until the matrix $D(n)$ is constructed. Matrix $D(n)$ i row j column is the number i vertex to j of the shortest distance.

3	6	0	∞	∞	∞	∞	∞	∞	∞
∞	∞	∞	2	∞	∞	∞	∞	∞	∞
∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
∞	∞	∞	4	∞	∞	∞	∞	∞	∞
∞	∞	∞	0	9	5	2	∞	∞	∞
∞	∞	∞	5	∞	6	∞	1	∞	∞
∞	∞	∞	∞	∞	∞	7	9	∞	∞
∞	∞	∞	∞	∞	∞	10	∞	∞	∞
∞	∞	∞	∞	∞	∞	∞	4	8	∞
∞	∞	∞	∞	∞	∞	∞	∞	7	∞

Figure 7 –Weighted Adjacency Matrix

In the process of implementation, the two dimensional array defines the following:

1. $cost[i][j]$ $cost[i][j]$: description of adjacency matrix is used to, if there is a path from the V_i to V_j can reach, $cost[i][j] = d$ said the length of the path; Otherwise, $cost[i][j] = 0$ $cost[i][j] = 0$.
2. $shortest[i][j]$ $shortest[i][j]$: Used to store from the V_i to V_j shortest path, as its initial value $cost[i][j]$ $cost[i][j]$.
3. $path[i][j]$ $path[i][j]$: Used to record from the V_i to V_j V_j on the shortest path of the precursor of point number, the sequence V_j . V_i is the output of the reverse V_i to V_j required to pass through the shortest path information.

When inserted the each vertex in the figure, successive comparison after the insertion point distance and the original distance, to find the shortest distance between two points.

Compiled, connection to generate an executable program, by writing the database and the database connection, the current data is submitted, by the above code extracted from the database operation and display the results to the front desk, realize scheduled program.

4.2. System Function and Characteristics

User management: operated by the administrator, including add, delete users, etc.

Resource management: the upload, download, copy, delete, attributes, check, etc.

Security (Chaudhary, A., Tiwari, V. N., & Kumar, A., 2016), rights management, different user operation to different folder permissions Settings;

Authorized operation: for different users can enjoy the use function of Settings;

Resource audit: only the examined resources can show, or upload after general users are not visible;

Statistical information: including conventional statistics, access statistics, system information, etc.

Log query: show the online user state in detail;

Node management: to add or remove operations such as node server;

System Settings: including resource option is set, the server option setting, system option is set, the home page option Settings, and so on. Option is set among them, the resources and coal resources to review the default Settings, page file directory number set preview the default setting, resource pricing default Settings, resources, resource URL default Settings, etc.;

User logged in, but in its resources with corresponding operating rights to upload, download, copy, paste, delete, attributes, check, etc., can also be for preview images, such as streaming media file;

You can download the free resources on the network, including common tools such as software;

Including the specific files, search scope, date, type, size, etc.

4.3. The Main Technical Parameters

Based on the large relational database, the openness and extensibility, running stability, systematical safety, applicability and practicability of the system.

4.4. The Technical Route

System adopts two level server structure design, the first level to the central server, its main function is each node server Shared resources unified management, synchronous update each node sharing information resources, providing resources Shared services. The second level for the node server, its role is largely subnet internal resources, for external access to a Shared resource, and resources for internal access. Its structure USES the system manage strategy and modular method, every module and USES the independent design, module design has a coupling between interfaces. Management system through policy configuration set of system functions, the overall technology roadmap as shown in figure 8. (Elsayed, S., Sarker, R., & Essam, D., 2015).

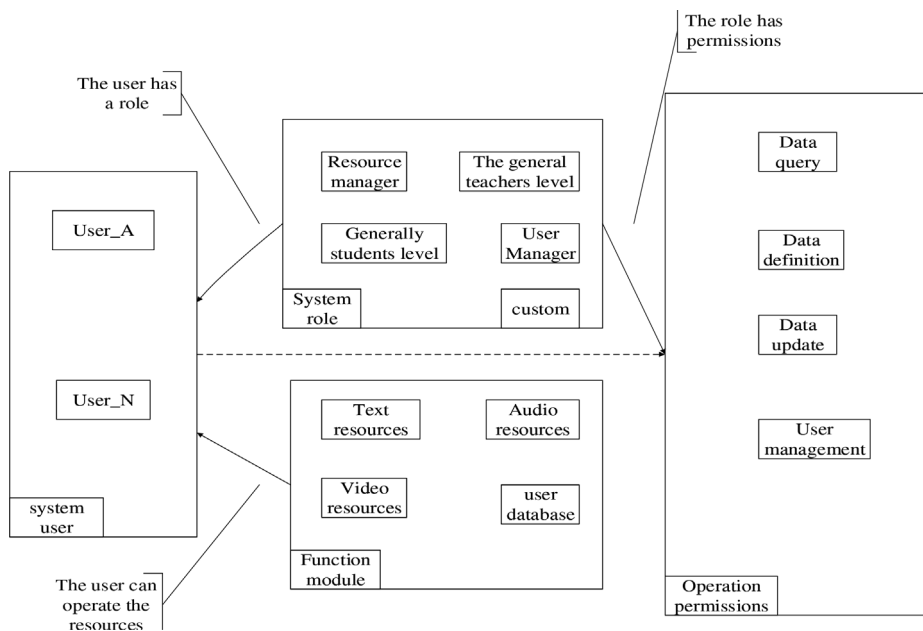


Figure 8 – General Technical Route of the System

About the file transfer, remote client using the FTP protocol to transfer resource file to the server, using the HTTP protocol update notification server resources, the server through the Kernel service program update import database data server, structure map as shown in figure 9.

At the same time, the system for user authentication data encryption algorithm adopts multi-layer authentication method, the user authentication using high-strength encryption algorithm to encrypt data, as shown in figure 10. User login authentication and password authentication mechanism, different users have different access permissions

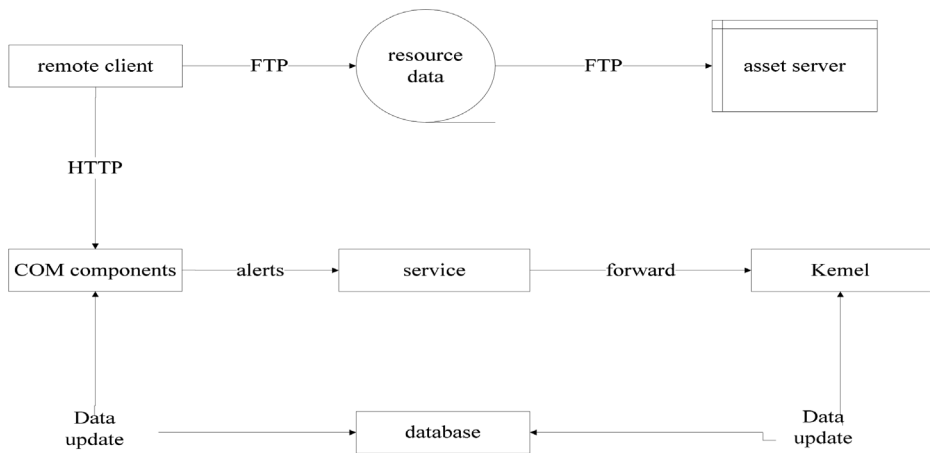


Figure 9 – The Structure of the File Transfer Roadmap

and access level, prevent the illegal user invasion and destruction. Users to add only administrator has the management of user authority by the administrator, you can assign permissions to users or lower access.

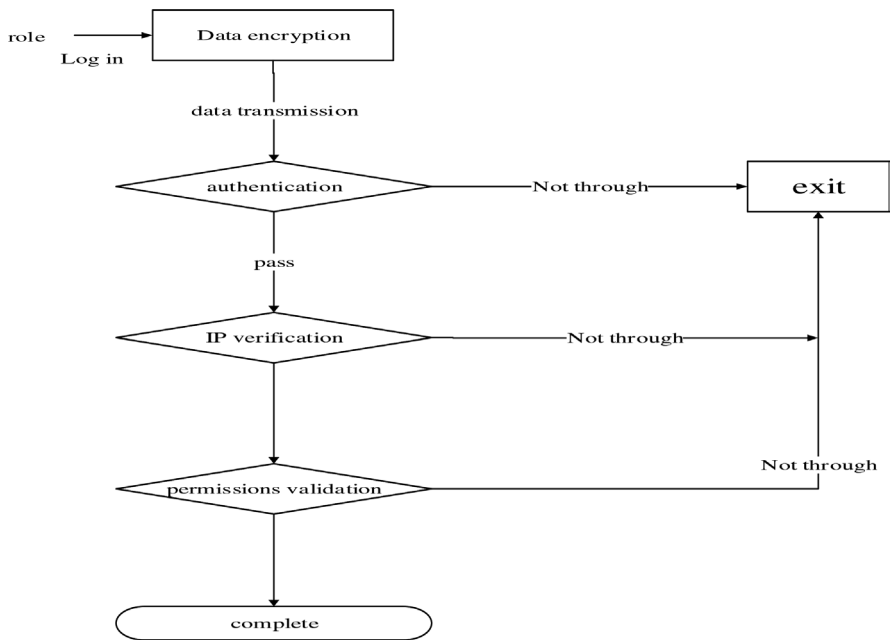


Figure 10 – User Authentication, Data Encryption Algorithm

4.5.Algorithm of Data Analysis

We can put some performance parameters of the network management (such as equipment rate of port) as a function of the change over time. Through the network

management practices, found that a large number of performance parameters in the process of change over time may change in a certain time interval is very gentle, in another time interval is obviously significant change some, so it's quasi and curve of the distortion degree is different also, as shown in the figure below:

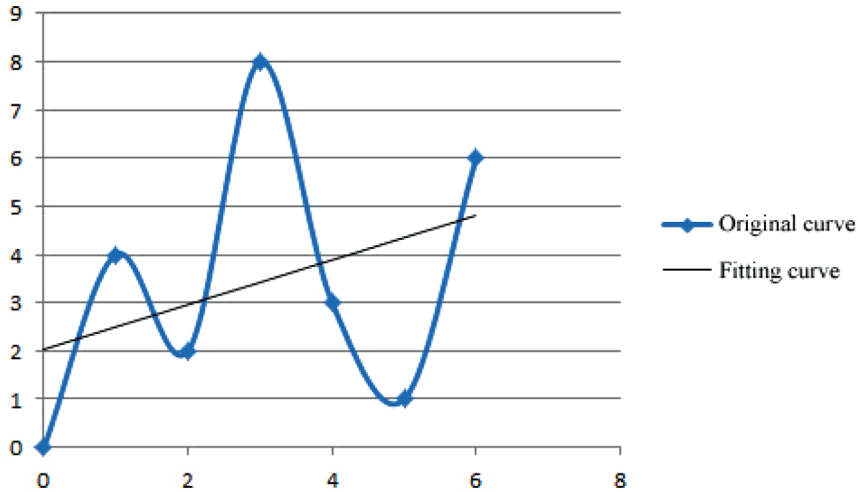


Figure 11 – Data Changes Violently

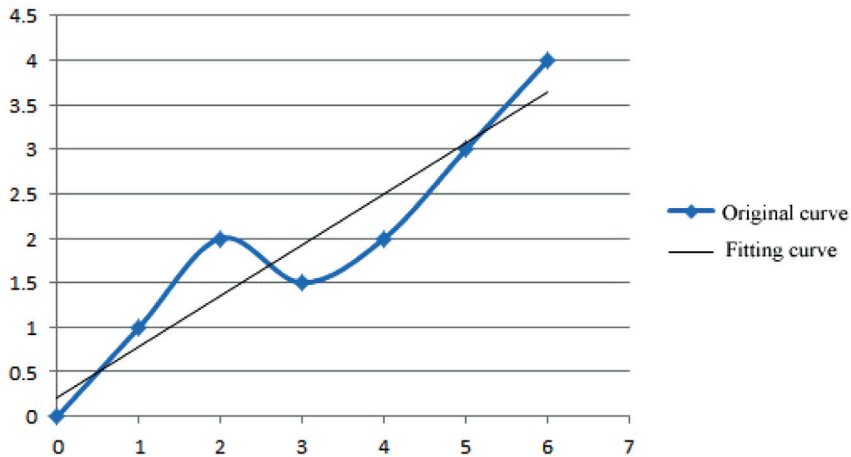


Figure 12 – Data Changes Gently

In order to improve the accuracy of the computer fitting and we must decrease the sampling period, and the original curve in the figure 11 and 10 due to its change over time, less volatile, even if we decrease the sampling period, the influence of also is not big, so in order to reduce the sampling frequency to try to reduce the system overhead, we can keep the original sampling period and even extend the sampling period.

In actual application, this simple method to improve the sampling frequency, although on the surface improves the sampling plan and the precision of curve in the original data changes significantly area, but the change of the original data smoothing the precision basically does not improve, because changes in the original data under the present sampling frequency flat area curve and the curve of the precision has high enough), it will cause the waste system bandwidth.

Adaptive time interval data acquisition algorithm is the main idea: according to the variation of the data to adjust the spacing between the sampling points of time, when the data changes smooth increase sampling time interval, and decrease the time interval.

On the premise of the same network bandwidth consumed, according to the adaptive sampling interval data acquisition algorithm of sampling plans and curve ratio obtained by sampling interval data acquisition algorithm are proposed and curve has less distortion. Also we can infer that in under the same precision of fitting and curve, adaptive time interval data acquisition algorithm will consume less than time interval such as data acquisition algorithm of system bandwidth. Adaptive time interval data acquisition algorithm provides the configuration parameters that algorithm can according to the characteristics of the different network performance parameters of flexible configuration, so that the algorithm has a larger scope.

5. Conclusion

In this article, we in the mobile agent technology development and application has carried on the thorough investigation and analysis, fully realize the importance of people's life in the future the technology and extensive application, at the same time, the construction of mobile campus of a careful research, has been clear about the mobile network management in colleges and universities, students' campus life has an important influence and role. We hope that we can use the mobile agent technology to better the construction of mobile campus, and bring convenience for schools and students. Through research and experiments we found that can take advantage of the mobile agent technology to build based on digital campus information into the movement of the campus network platform, implement all kinds of information to the school's summary, screening, classification, sharing, query and use, and other functions.

Digital campus based on computer network, the traditional PC as the terminal equipment, can't realize the exchange of information, information services anytime and anywhere; Due to the lack of unified model to guide the construction of the early lead to various information website, scattered distribution of digital services, office management system, information isolated island phenomenon is serious; Information resources utilization rate is low, simply present information cannot provide users with personalized service.

With the progress of information technology, computer technology and management technology, the application of mobile technology in theory and the way of development on the enormous development, its application field is becoming more and more widely, for real-time tracking of the management of university students, has provided the safeguard information integration, information sharing, improve the efficiency of management. Colleges and universities has the congenital advantage in the use of

information technology, the construction of mobile campus, thus achieve the campus mobile information services for universities to achieve “one person one, walk through the campus” convenient, efficient, timeliness strong modern university service management concept, will inevitably promote the development of higher education.

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Research on the Methods of Identifying Defect Positions of Anchor System Based on Instantaneous Frequency

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Abstract: In anchor system, it is hard to identify the defect position through non-destructive testing wave when a number of defects exist in the system. This paper identifies the multiple defect positions in the anchor system by the method of combining wavelet decomposition with instantaneous frequency. At first, db6 wavelet basis function is used to conduct multi-scale one-dimensional wavelet decomposition of the acceleration signal obtained through numerical simulation. Then the first layer of decomposed detailed information is demodulated with Hilbert transform to obtain the instantaneous frequency. With the instantaneous frequency parameter, the defect position can be identified. The identification result is in accordance with the theoretic calculation. This research provided certain references for the non-destructive detection of multi-defect anchor system in practical engineering.

Keywords: Anchor system; multi-defect; wavelet decomposition; hilbert transform; instantaneous frequency.

1. Introduction

As an important technology in geotechnical engineering and geological engineering, anchor technology has been widely used in all around the world. The quality of anchor system is crucial to the engineering safety. Hence, effective testing of the anchor quality has been largely concerned. Currently, non-destructive testing is a common method of testing anchor quality, and the stress wave reflection method is one of the widely applied. In this method, a hammer is used to generate a sound impulse at the exposed end of the anchoring bolt. When transmitting lengthwise along the anchoring bolt, the sound impulse will reflect if it came to the interface that wave impedance was changed (defect in the anchor system will lead to the change of the wave impedance). It means that reflection wave will be produced at the defect position. It shows that the reflection wave signal at the exposed end of the anchoring bolt contains abundant information that can

reflect the defect of the anchor system. In this way, the reflection wave signal can be used to identify the position and degree of the defect (Si, T., Yin, C., Gao, P., Li, G., Ding, H., He, X., ... & Xu, R. X., 2016). Taking the full-length bonded bolt as the simulation object, Qin Qiang (Bin, D., & Hongzhi, Y., 2015) et al. studied the transmission law of the reflection wave in the anchor system under the cases of one single defect with different distribution positions and two defects, and judge the position and length of the mortar defect in the anchor system through the attenuation law of the reflection wave. Through numerical simulation and experiment, Yao Luo (Zhang, Y., Deng, Z. C., & Hu, W. P., 2016) studied the reflection law of the stress wave at the defect position of the anchor system, decide the defect position according to the time history curve, and evaluate the anchor quality by inverting the anchor wave velocity. However, in the real testing practices, reflection wave is usually mixed with other waves and cannot be identified effectively, especially for the deep weak reflection wave signals. In particular, when there are a number of defects, the signals became even more complicated due to the mix up of the reflection waves at various interfaces that wave impedances were changed (Funada, M., 2015). In order to improve the accuracy of the signal identification, people tried many methods and the most commonly used is the wavelet decomposition method. For example, Xiao Guoqiang (Antonopoulos, C. G., 2016) et al. found out that, in the wavelet domain, the high-frequency wavelet composition of the reflection wave at different interfaces can be well separated by multi-scale wavelet decomposition of the theoretical model curve and on-site testing signals. Yan Shilin (Chai, J., Jin, A., & Wu, S., 2015) et al. also treated the reflection wave through wavelet analysis method. The result shows that, this method can better reflect the anchor status and improve the reliability of the anchor quality evaluation, compared with the method of using original signal directly. In the case of multiple defects, it is difficult to accurately identify the defect position with just the single wavelet analyzing method. It should be tested with other signal analyzing methods together. For example, Yang Jianhui (Gandiolle, C., & Fouvry, S., 2015) et al. obtained the zero defect reflection signal, one defect signal and two defect signal of the stress wave of the anchor system through the experiment. Then they use the wavelet analyzing tool to extract the wave that can reflect best the current vibrating condition, and use the vibrating wave and time-frequency spectrum to determine the anchor quality and defect position. On account of the cases of three or four defects existed in the anchor system, this paper adopts db6 wavelet basis function to conduct the multi-scale one dimensional wavelet decomposition of the acceleration signal obtained by numerical simulation. Then the first layer of decomposed detailed information is demodulated with Hilbert transform to obtain the instantaneous frequency. Through the instantaneous frequency parameters, the defect position and defect length can be identified, which provided certain references for the detection of the defect position of multi-defect anchor system (Felizardo, V., Sousa, P., Oliveira, D., Alexandre, C., Garcia, N. C., & Garcia, N. M., 2014).

2. Obtaining of Non-destructive Testing Signals of Anchor System with Defects

2.1. Finite Element Model and Parameter Setting

This paper established the anchor system model with ANSYS/LS-DYNA software, and takes the acceleration signal of the node at the center of the free exposed end of the

anchoring bolt as the study object. The anchoring bolt is 0.02m in diameter, 2.2m in length. The anchoring part is 0.3m in length. The drill hole is 0.028m in diameter and the tray is 0.08m in diameter. Epoxy resin is used as the anchoring agent. The elasticity modulus of the anchoring bolt, anchoring agent and the surrounding rock are 210GPa, 16GPa and 25GPa respectively; the density are 7800 kg/m, 1800 kg/m, and 2300 kg/m³ respectively; the Poisson's ratios are 0.30, 0.25, and 0.28 respectively. The whole infinite element model uses the 3D structural solid element SOLID164 to conduct the explicit dynamical analysis. The infinite element model grid is shown as Figure 1.

Normal constraints are applied to the bottom of the surrounding rock and non-reflecting boundary is set around the surrounding rock to weaken the impact of the reflection wave at the model boundary on the simulation results (Gobbi, G., Colombo, C., & Vergani, L., 2015). The drive signal of the numerical simulation adopts half sine wave signal to act on the circular area (0.005m in radius with the central area of the end face as the center) at the free exposed end of the anchoring bolt in the form of force loading along the axial direction of the anchoring bolt (Kuznetsova, T. Y., 2015).

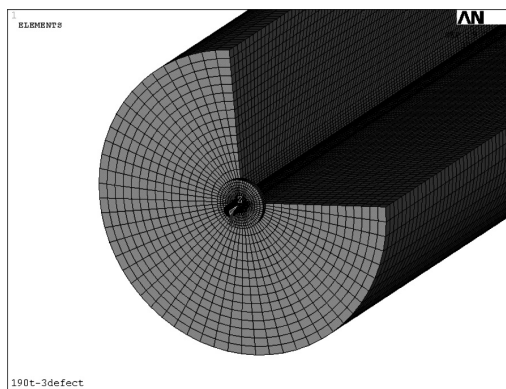


Figure 1 – Schematic Diagram of Mesh Generation

2.2. Defect Parameters and Locations

This paper studied the cases of 3-defect and 4-defect anchor systems. The length of the defect is 1cm. The type of defect is the anchoring agent missing and anchoring bolt exposed completely. For the case of 3 defects, both of the distances from the defect position to the anchoring start end and between the defect positions are 7cm, and from the defect position to the anchoring part bottom is 6cm; for the case of 4 defects, both of the distances from the defect position to the anchoring start end and between the defect positions are 5cm, and from the defect position to the anchoring part bottom is 6cm. The locations of the defects and the model parameters are shown as Figure 2:

2.3. Signal Characteristics

The acceleration signals obtained from numerical simulation are shown in Figure 3. As the signals before 0.7ms are overlapped, the figure only presented signals between 0.7ms and 1.02ms. As shown in Figure 3, in the 3-defect model, the reflections at the anchoring

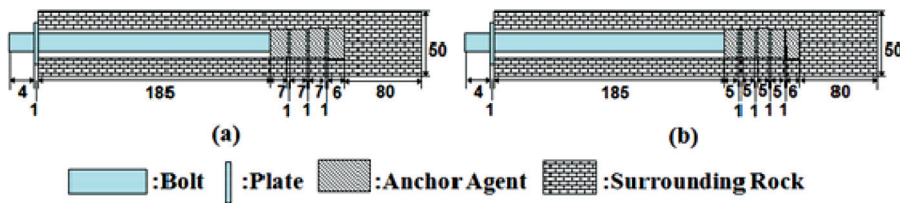


Figure 2 – Models of Defective Anchor System (Unit: cm) (a. Three defects Model; b. Four Defects Model)

start end and the anchoring part bottom are evident; while in the 4-defect model, the reflection at the anchoring start end is evident, but the reflection at the anchoring part bottom cannot be identified accurately. Besides, it is hard to distinguish the reflection wave between the upper and lower faces of the defect through the chart of the acceleration signal changing with time. Hence, the signals need to be further processed so that the information of the defect position can be reflected clearly.

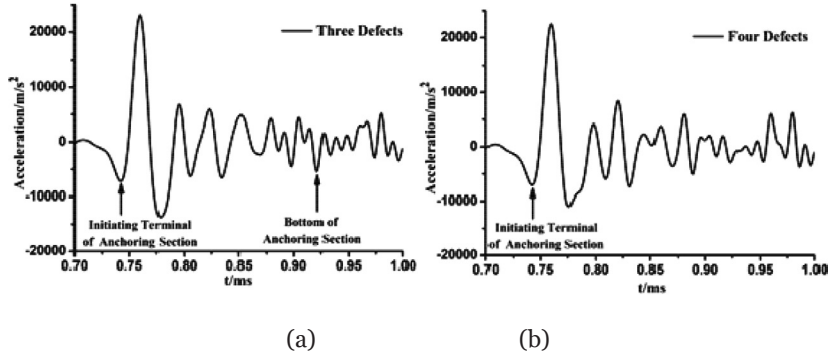


Figure 3 – Acceleration Signals of Multiple Defects Anchor System. (a. Three Defects Model; b. Four Defects Model)

3. Identification of Defect Positions

According to the wave theory and elastic wave propagation theory, the reflection wave at the interface with wave impedance mutations is consisted of a series of low-frequency and high-frequency components. During the propagation of the sub-wave of the low-frequency components, as the energy decreases slowly which requires longer time of particle vibration, the particle vibration caused by the reflection waves of neighboring interfaces will be overlaid onto original vibrations before the particle vibration stops completely. Hence, it is difficult to distinguish the reflection waves of different interfaces according to the received waveforms. On the contrary, the sub-wave energy of high-frequency component decreases fast which requires shorter particle vibration time. When the particle vibration stops completely, the reflection waves of the neighboring interfaces have not arrived. As a result, the high-frequency component sub-waves of the reflection waves of different interfaces are separated. These parameters can be used to easily distinguish the arriving time of the reflection waves of different interfaces

(Wang, Y. Z., Liu, D., Wang, Q., & Zhou, J. Z., 2016). Based on the above reasons, in order to accurately identify the location of the defected interface, the high-frequency component in the signal should be separated first, which can be realized by the multi-scale one-dimensional wavelet decomposition.

3.1. Wavelet Transform

Wavelet transform is a multi-scale signal analyzing method and a powerful tool of analyzing non-stationary signals. The method can analyze both the appearance of the signal and the detail of the signal (Yu, R., Bai, X. S., & Bychkov, V., 2015). Having overcome Fourier transform's disadvantages of no time localization and fixed resolution of short time Fourier transform, wavelet transform is widely applied in the field of signal analysis. With the dilation and translation of wavelet basis, the time-frequency localization analysis of the signal can be realized, which can also maintain both the time-domain feature and the frequency-domain feature. As a self-adaptive time-frequency localization method, its window shape automatically changes to flat for low-frequency signals, and changes to lanky for high-frequency signals. Continual one-dimensional wavelet transform for continual signals $f(t)$ can be defined as (Kureková, E., Omachelová, M., Halaj, M., & Martišoviš, I., 2015):

$$\text{CWT}[f(t)] = \frac{1}{\sqrt{|a|}} \int_{-\infty}^{\infty} f(t) \psi_{a,b}^*(t) dt \quad (1)$$

Based on the wavelet function, two groups of filter banks as H and G can be constructed. G refers to low-pass filter, which extracts the approximate value cA (low-frequency coefficient) of the original signal S; H stands for high-pass filter, which extracts the detailed information cD (high-frequency coefficient) of the original signal S. The decomposition process is shown as Figure 4 (Kureková, E., Omachelová, M., Halaj, M., & Martišoviš, I., 2015):

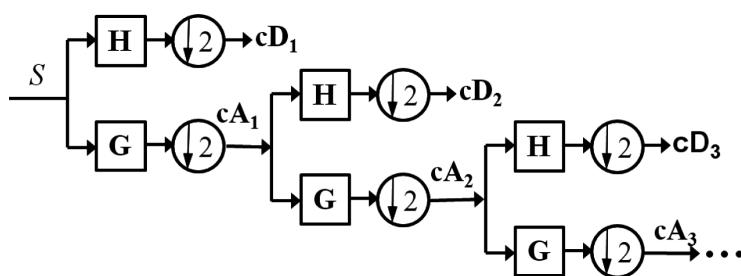


Figure 4 – Multilevel 1-D Wavelet Decomposition of Acceleration Signals

As shown, the cA coefficient in the wavelet decomposition method retains the low-frequency information or approximate information of the original signal, while cD coefficient retains the high-frequency information or detailed information of the original signal (Nath, G., 2016).

After using Matlab to write the wavelet decomposition program and conducting abundant computations, the study finally chose the db6 wavelet basis in the Daubechies wavelet

family to conduct the wavelet decomposition on the acceleration signal obtained from numerical simulation, and obtained the decomposed signal of the first layer of detailed information, which is the high-frequency component of the signal as shown in Figure 5.

3.2. Calculation of Instantaneous Frequency and Identification of Defect Positions

As shown in Figure 5, in the high-frequency section (cD_1), the reflection waves of different interfaces are separated after wavelet processing. However, as there are too much signal peaks, it is hard to accurately read the information of the defected interface. So a Hilbert transform was conducted on the cD_1 signal and the instantaneous frequency was calculated. Then the parameters of the instantaneous frequency was used to identify the defect position. The specific method is shown as following (Jureková, Z., Húska, D., Kotrla, M., Prčík, M., & Hauptvogel, M., 2015):

First, Hilbert transform is conducted by using Formula (2) on cD_1 , which means the convolution of signal and time reciprocal.

$$H[x(t)] = \hat{x}(t) = \frac{1}{\pi} \int_{-\infty}^{\infty} \frac{x(\tau)}{t - \tau} d\tau \quad (2)$$

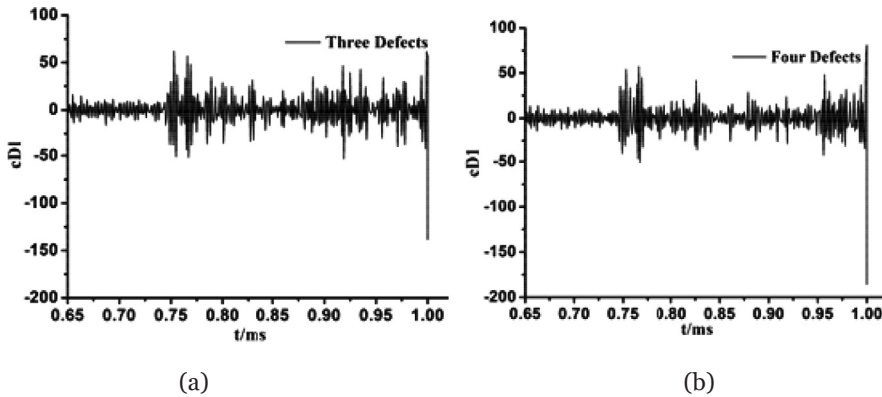


Figure 5 – Wavelet Decomposition Signals of the First Layer Detail Information. (a. Three Defects Model; b. Four Defects Model)

The actual signal and its Hilbert transform can form an analytic signal.

$$z(t) = x(t) + j\hat{x}(t) = a(t)\exp(\varphi(t)) \quad (3)$$

Where, $a(t)$ stands for the amplitude of analytic signal; $\varphi(t)$ stands for the phase position of the analytic signal. The phase position of the signal can be calculated by Formula (4).

$$\varphi(t) = \arctan \frac{\hat{x}(t)}{x(t)} \quad (4)$$

The instantaneous frequency of the signal can be obtained by the first-order derivative of signal phase position and time.

$$\omega(t) = \frac{d\varphi(t)}{dt} \quad (5)$$

There will be a sudden change in the wave form when the stressed wave arrived at the defect boundary. In response, the instantaneous frequency will be also changed obviously. Hence, the moment when the instantaneous frequency is evidently changed on the instantaneous frequency–time relation curve is the moment when the stressed wave is propagated to the defect boundary. Then the defect position can be identified.

The time change curve of the instantaneous frequency of the signal is shown as Figure 6. The read results and the theoretical values in the figure are compared as Table 1. As shown in Table 1, the read values and the theoretical values are very close. The maximum deviation in the 3-defect model is 0.85%, and the maximum deviation in the 4-defect model is 0.50%.

Formula (6) is used to conduct the theoretical calculation:

$$t = \frac{2 \times l_{\text{free}}}{v_{\text{free}}} + \frac{2 \times l_{\text{Anchorage}}}{v_{\text{Consolidation}}} \quad (6)$$

Where $v_{\text{free}} = 5172 \text{ m/s}$, $v_{\text{Consolidation}} = 3113 \text{ m/s}$.

As shown in Figure 6, the instantaneous frequency will have a sudden change when arriving at the anchor start end from sparse medium to dense medium, which is correspondent to the peak value (as shown in (1) in Figure 6(a)) or the valley value (as shown in (1) in Figure 6(b)).

Meanwhile, the instantaneous frequency will also have an obvious change when arriving at the defect start end from dense medium to sparse medium, as shown in (2), (4) and (6) in Figure 6(a) and (2), (4), (5) and (7) in Figure 6(b). The change of the instantaneous frequency is more evident when the defect is closer to the anchor start end, and weaker when farther to the anchor start end, as shown in (7) in Figure 6(b). It is perhaps that during the propagation process, although the sub-wave energy of the high-frequency component decreases fast, the distance from the defect to the anchor start end is far and with a certain number of defects, these waves are overlapped with the sub-waves of the high-frequency components reflected by other interfaces, which makes the change of instantaneous frequency not evident.

For the tail end of the defect, where wave transmits from sparse medium to dense medium, its instantaneous frequency changed a lot comparing with that of the start end, as shown in (2)-(3), (4)-(5) and (6)-(7) in Figure 6(a), and (2)-(3), (5)-(6) and (7)-(8) in Figure 6(b). Meanwhile, the change of the instantaneous frequency at the tail end is more evident when the defect is closer to the anchor start end, and weaker when the defect is farther, as shown in (7) in Figure 6(a) and (8) in Figure 6(b). The reason is similar to that of the defect start end.

For the anchor end, the change of instantaneous frequency is weak as shown in (8) in Figure 6(a) and (9) in Figure 6(b). This is because the position is far from the sensor and multiple defects existed in the anchoring system, thus the reflections are overlapped

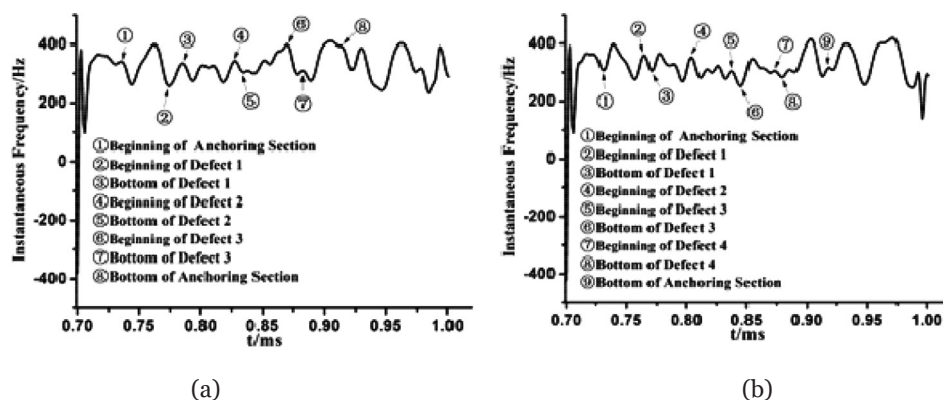


Figure 6 – The Instantaneous Frequency Vs Time Curves. (a. Three Defects Model; b. Four Defects Model)

in the propagation process to the exposed end of the anchoring bolt and cannot be separated completely.

	Three defects model			Four defects model		
Position	Readout value /ms	Theoretical value /ms	Error	Readout value /ms	Theoretical value /ms	Error
Beginning of Anchoring Section	0.735	0.7347	0.04%	0.731	0.7347	0.50%
Beginning of Defect 1	0.774	0.7797	0.73%	0.765	0.7668	0.23%
Bottom of Defect 1	0.785	0.7836	0.18%	0.771	0.7707	0.04%
Beginning of Defect 2	0.828	0.8286	0.07%	0.804	0.8028	0.15%
Bottom of Defect 2	0.835	0.8325	0.30%	—	—	—
Beginning of Defect 3	0.870	0.8775	0.85%	0.838	0.8388	0.10%
Bottom of Defect 3	0.882	0.8814	0.07%	0.845	0.8427	0.27%
Beginning of Defect 4	—	—	—	0.873	0.8748	0.21%
Bottom of Defect 4	—	—	—	0.880	0.8787	0.15%
Bottom of Anchoring Section	0.914	0.9199	0.64%	0.918	0.9172	0.09%

Table 1 – Comparison of the Read Value and Theoretical Value of the Corresponding Time at Different Positions

4. Conclusion

This paper simulated the propagation process of stressed wave in the anchor system with multiple defects with ANSYS/LS-DYA software, used db6 wavelet basis function

to conduct multi-scale one-dimensional wavelet decomposition of the reflection wave signal, proceeded the Hilbert transform on the first layer of decomposed detailed information, then calculated the instantaneous frequency of the decomposed signal, identified the defect positions with instantaneous frequency curve, and came up with the following conclusion:

1. The instantaneous frequency change at the anchoring start end is evident, which is easy to identify;
2. The change of the instantaneous frequency is more evident when the defect start end is closer to the anchor start end; the change is weaker when the distance is larger;
3. There is a large difference between the instantaneous frequency at the defect back end and at the start end. The change of the instantaneous frequency at the back end is more evident when the defect start end is closer to the anchor start end; the change is weaker when the distance is larger;
4. The change of the instantaneous frequency at the anchor tail end is not evident, but still distinguishable.

With the reflection signal processed by “Wavelet decomposition — Hilbert transform — Instantaneous frequency calculation”, the locations of multiple defects existed in the anchor system can be identified, which provides certain references for the non-destructive testing signal analysis of the anchor system.

Acknowledgment

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A Study on New Detection and Control Approaches of Distortion Currents for Active Power Filters

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Abstract: Based on the theory of single cycle control, the control technique and its latest application of constant frequency integration are presented and realized. A general active power filter with constant frequency integral reset control is proposed and implemented. With theoretical analysis and comparative analysis, the mathematical model of APF is established, which is used to realize the APF common frequency integral reset control circuit and APF system with common frequency integral reset control. Finally, a 500W experimental prototype is designed, installed and debugged. The dynamic and static compensation performance of three different kinds of nonlinear loads are studied experimentally and practically. The experimental results confirm the correctness of theoretical analysis. Compared with the traditional APF, the new control method of APF has a strong advantage.

Keywords: Active power filters; harmonics currents; detection; control.

1. Introduction

With the development of power electronic technology, the power grid harmonic pollution caused by a large number of nonlinear devices is becoming increasingly serious. Active power filter (APF) is the most ideal solution to restrain the harmonic current. (Ng, K., 2016) The key technology of APF is the detection of the harmonic current and the tracking control of the compensation current, and the harmonic current detection method is the given value. The performance of the harmonic current detection method directly influences the effect of the active power filter; The accuracy of harmonic current detection is affected by the steady state accuracy of current compensation, and the dynamic response performance of current compensation is affected by the speed. (Freixo, J., & Rocha, Á., 2014) In this paper, the main methods of harmonic current detection at home and abroad are summarized, and the harmonic detection method of engineering application is introduced (Cobb, B. R., 2016).

1.1. Harmonic Current Detection Technology

Harmonic current detection technology is the field of electronic technology and signal processing, basic theory for power definition theory and signal processing theory.

At present, the classification of the detection method is generally divided into two categories: time domain and frequency domain. According to the theory of harmonic detection method, it is divided into two categories based on power definition and digital signal processing technology. The theory of harmonic detection based on power definition is developed on the basis of the definition of power, and the technology of harmonic detection based on signal processing theory is the application of signal processing technology in the detection of harmonics. the author of the common detection method of classification and summary is showed in Fig.1 (Peter, J. G., Dlamini, S., & Lehloeny, R. J., 2015).

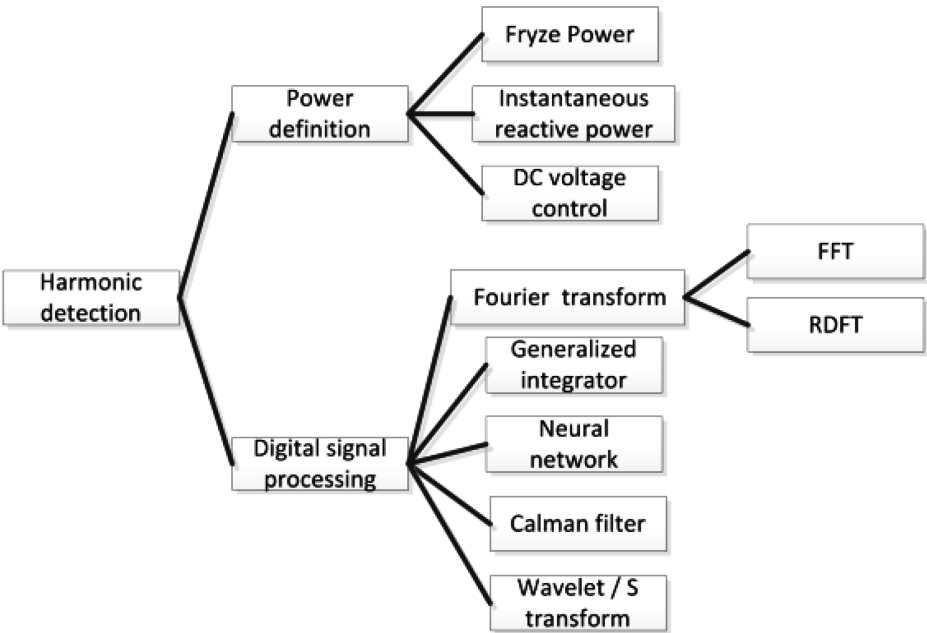


Figure 1 – Classification of Harmonic Detection Method

1.2. Power Harmonic Compensation and Suppression

By using the method of limiting harmonic source can effectively reduce the harmonics in power system. But because of the complexity of diversity in the power system harmonic and power system, to completely eliminate the harmonic is not possible. Therefore, it is a very important research direction to compensate the power grid harmonics and compensate the reactive power simultaneously (Peters, G. J. Y., Ruiter, R. A. C., & Kok, G., 2015).

The traditional method to suppress the higher harmonics is to use LC Passive Power Filter(PPF for short). PPF is generally based on the principle of resonance to work. It has the advantages of simple structure, low cost, low operation cost, and the absorption of a specific second harmonic effect, and also can compensate the reactive power. However, due to the structural principle of the reasons, there are some disadvantages in the application of the following difficult to overcome (Kim, M. S., Ong, M., & Qu, X., 2016).

1. which can only inhibit the design requirements of the harmonic components. Sometimes, because of the high harmonic components, multiple filters must be added at the same time. This will increase the cost and volume of the whole filtering device (García-Rodríguez, R., Villanueva-Cab, J., Anta, J. A., & Oskam, G., 2016);
2. overload may be caused by the passive power filter harmonic current when excessive, damage to equipment;
3. its filtering characteristics are influenced by the working state of the power network structure and power frequency drift, and it is difficult to obtain the desired filtering effect;
4. for special harmonics, or when the system impedance and frequency changes, it may be due to the power supply of the parallel resonance and resonance and produce “harmonic amplification”, so that the circuit can not work;
5. it is possible to generate series resonance with power system, which can cause voltage distortion and generate additional harmonic current flowing into the passive filter, and the filtering effect is related to the power system.

In this paper, the hardware circuit is proposed to realize the harmonic and reactive current detection based on the effective value of compensation current, and the APF model of the proposed detection and control method is studied by theoretical analysis, system design, simulation, installation and debugging. The results confirm the correctness of the proposed theory and method (Richardson, P. G., Palumbo, A., Schey, S. A., Dimopoulos, M. A., Facon, T., Weisel, K. C., ... & Mikhael, J. R., 2015).

2. The Principle and Method of Detecting the Distortion Current of Lcc By Using Hardware Circuit

The distortion current detection of LCC can meet the requirements of the active power filter to detect the distorted current. Have the advantages of high accuracy, good real-time performance, strong anti-interference ability, etc.. In addition, due to the ANN with self-learning ability and adaptive ability, the new scheme is not affected by the impact of the power grid structure and load changes, is a suitable method for active power filter is more ideal distortion current detection method. In electric power system, it has very good application prospect, but it is realized by using artificial neural network. At present only the use of computer or high-speed DSP (digital signal processing chip) use software to achieve. Calculation of the workload, control circuit structure is more complex (Zhang, Y., & Pan, H., 2015).

The detection of harmonic and reactive current in nonlinear load current $i_L(T)$ is first converted into the problem of determining the amplitude of the fundamental active current in $i_L(T)$, and then the problem is further transformed into the problem of minimizing the Irms. The key task of the LCC distortion current detection circuit is to complete the adjustment of the minimum compensation current. (Liu, S. W., Li, Y. Z., Lin, S. Y., Li, Y. H., & Lee, C. C., 2016) In order to realize the LCC regulation in the hardware circuit, this paper discusses the structure of the compensation current and the root mean square value of the expression (V Dumitru, S., & N Kosmas, E., 2015; Mah, A., & Wright, A., 2016).

Instruction current function:

$$\begin{aligned} i_c(t) &= i_L(t) - A \sin \omega t = i_c(t) + i_{1p}(t) - A \sin \omega t \\ &= i_c(t) + (A^* - A) \sin \omega t \end{aligned} \quad (1)$$

RMS value of instruction current function:

$$I_{rms} = \sqrt{\frac{1}{T} \int_{t-T}^t i_c^2(t) dt} = \sqrt{\frac{1}{T} \int_{t-T}^t (i_L(t) - A \sin \omega t)^2 dt} \quad (2)$$

Adjust the parameters in $i_c(t)$, so that the $i_c(t)$ rms value of the minimum, when:

$$\min[I_{rms}] = \min \left[\sqrt{\frac{1}{T} \int_{t-T}^t i_c^2(t) dt} \right] = I_{rmsmin} \quad (3)$$

It should be:

$$A^* = A \quad (4)$$

$$i_c(t) = i_c^*(t) = i_L(t) - A^* \sin \omega t \quad (5)$$

We first discuss the change ratio of I_{rms} to A , and then,

$$\frac{\partial}{\partial A} [I_{rms}^2(t, A)] = \frac{1}{T} \int_{t-T}^t -2(i_L(t) - A \sin \omega t) A \sin \omega t dt \quad (6)$$

$$2I_{rms}(t, A) \frac{\partial [I_{rms}(t, A)]}{\partial A} = \frac{2}{T} \int_{t-T}^t A \sin^2 \omega t dt - \frac{2}{T} \int_{t-T}^t i_L(t) \sin \omega t dt \quad (7)$$

In order to simplify the analysis, the A is considered as a constant in the integral period, and the formula (6) is considered:

$$\int_{t-T}^t A \sin^2 \omega t dt = A \int_{t-T}^t \sin^2 \omega t dt = \frac{T}{2} A \quad (8)$$

$$2I_{rms}(t, A) \frac{\partial [I_{rms}(t, A)]}{\partial A} = A - \frac{2}{T} \int_{t-T}^t i_L(t) \sin \omega t dt \quad (9)$$

When $I_{rms}(t, A)$ reaches a minimum value, $\frac{\partial [I_{rms}(t, A)]}{\partial A} = 0$. Since I_{rms} is limited, it must be,

$$A - \frac{2}{T} \int_{t-T}^t i_L(t) \sin \omega t dt = 0 \quad (10)$$

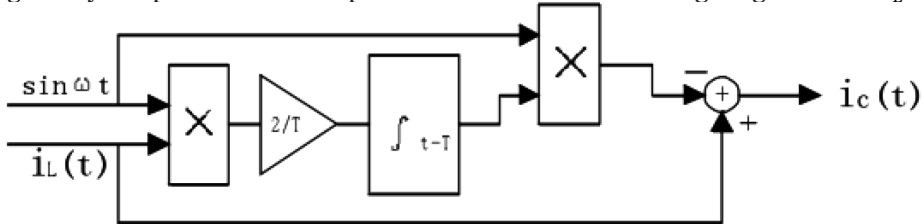
So far, we have derived an important conclusion from the assumption that the A is constant in the integral period:

When I_{rms} takes the minimum value, $A = A^* = \frac{2}{T} \int_{t-T}^t i_L(t) \sin \omega t dt$.

We can directly determine the amplitude of the fundamental active current component of $i_L(t)$ in A^* . In Fig.2 is the distortion current detection circuit designed according to the formula (10).

Figure 2 – Detection Scheme for Harmonic Candreactive Currents Based on LCC

The standard sinusoidal signal $\sin \omega t$ can be obtained directly from the power supply voltage or by the phase locked loop circuit and the sinusoidal signal generator. $i_L(t)$ for



nonlinear load current. $i_c(t)$ is the sum of the harmonic and reactive current detected by $i_L(t)$, that is, the distorted current signal. In the same way, if we want to separate the reactive current of the $i_L(t)$, then we can get the same derivation process according to the above (Bae, S. H., Moon, S. K., Kim, Y. H., Cho, K. H., Shin, E. J., Lee, M. S., ... & Yun, J., 2015).

$$B = \frac{2}{T} \int_{t-T}^t i_L(t) \cos \omega t dt \quad (11)$$

Fig.2 is for the detection of $i_L(t)$ in the harmonic circuit.

The integrated circuit in the graph can be realized by the circuit shown in Fig.4. In Fig.4 the integral circuit, analog integrator integrating circuit of conventional operational amplifier. Time delay circuit, a power supply cycle, can be used in sound amplifying circuit for echo and reverberation of special digital delay circuit chip such as PT2394/2395 or CMOS M50195P digital echo ic (Jing, G. F., 2016).

In this paper, the author designs a LCC control of active power filter in Fig.5 which can be used for the harmonic and reactive power compensation of the controllable rectifier device with the inductive load of electric locomotive. $\sin \omega t$ is a unit amplitude sinusoidal signal with the same frequency and phase with the grid voltage. i_L is a nonlinear load current, i_s is a power supply current, and the i_c is active power filter output. The whole system is composed of two parts, which are based on the instruction current operation circuit and the compensation current. After the i_L unit is multiplied by the sine function, the A (T) of the $2/T$ (power frequency cycle) of the power grid voltage is integrated into the definite integral circuit and the amplitude of the fundamental active current component is detected by using an amplification factor. DC voltage stability of PWM inverter DC side voltage. PWM controller generates the required compensation current

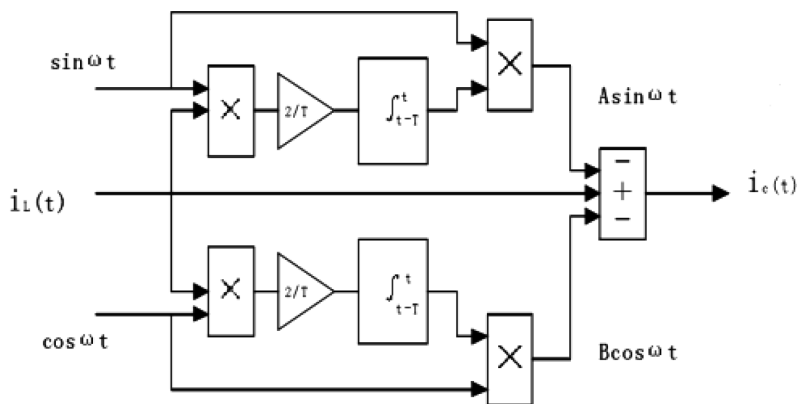


Figure 3 – Detection Circuit for Harmonic Current Based on LCC

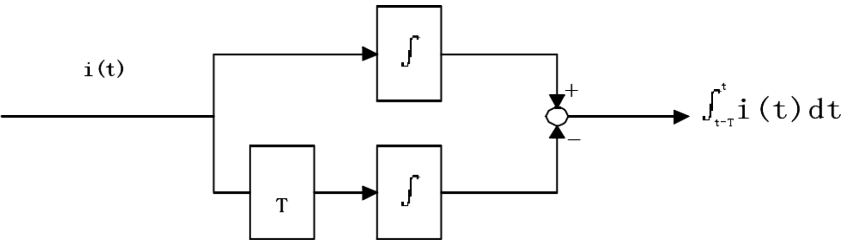


Figure 4 – Realized Circuit Block Diagram of Definite Integral

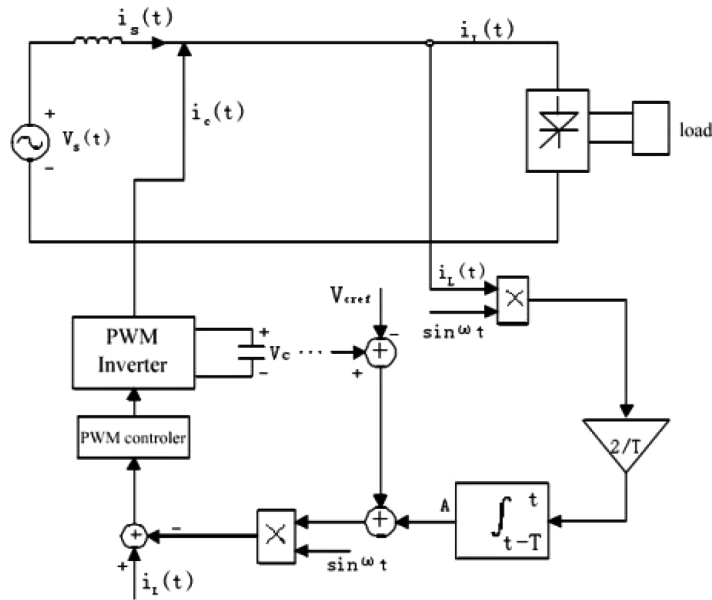


Figure 5 – A Scheme of APF Based on LCC Control

to control the PWM inverter based on the detected instruction current, and the harmonic and reactive current in the power network are offset. The PWM inverter is composed of four single phase bridge voltage inverter which is composed of IGBT.

Control mode of PWM inverter to generate the corresponding compensation is a lot of control methods, the requirements of the dynamic characteristics of the active power filter are considered comprehensively. In this paper, the current model following method is used. The working principle can be explained by the simplified equivalent circuit of the PWM inverter bridge as shown in Fig.6 and Fig.7. S_1, S_2 is two equivalent bridge arm switch, E_1 and E_2 are constant voltage source. $u_s(t)$ for power supply voltage.

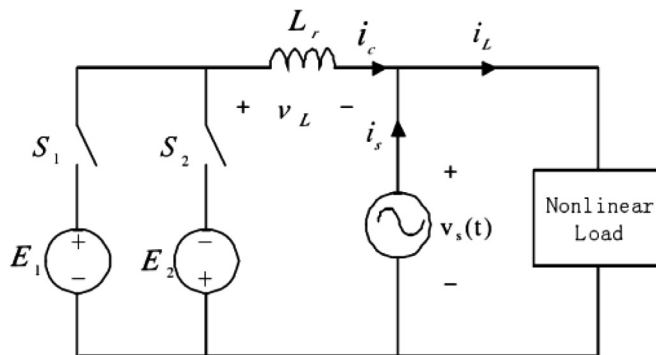


Figure 6 – Simplified Equivalent Circuit of APF Power Stage

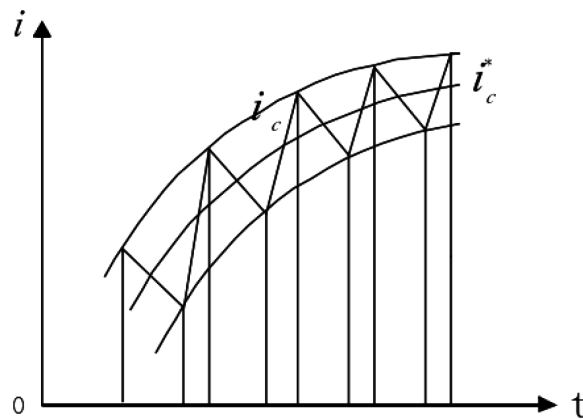


Figure 7 – Operation Wave for Msf Following Currents

Such control of the S_1, S_2 switch state can make the actual compensation current i_c and tracking the change of the i_c^* , the current waveform is shown in Fig.8 resulting in compensation current.

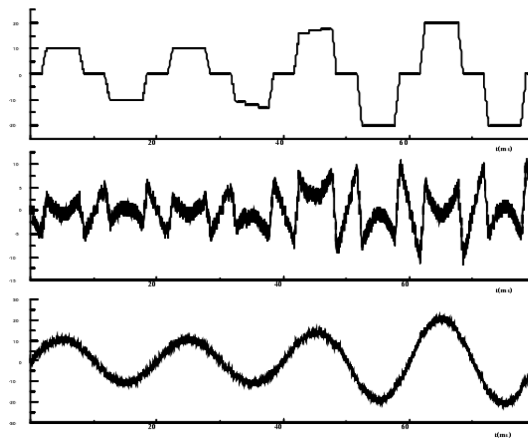


Figure 8 – Simulation Wave Forms With the Load Current Increase 100% At one Cycle. Top: Load Current; Middle: Apfcurren; Bottom: Load Current

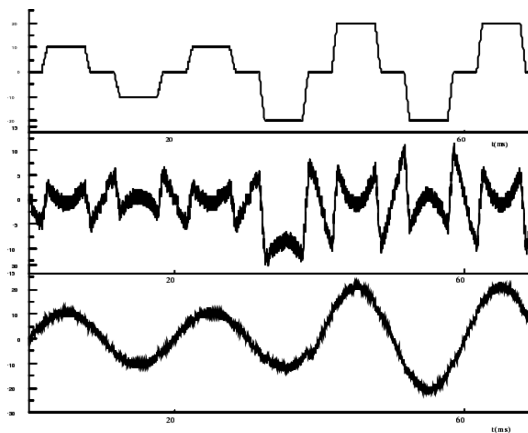


Figure 9 – Simulation Wave Form With the Load Current Stepped Increase 100%. Top: Load Current; Middle: APF Current; Bottom: Load Current

In order to verify the previous analysis, this paper carried out a simulation study of the 4 circuits, and the simulation results are shown in Fig.8, 9 and 10. The simulation results show that the APF based on the LCC harmonic current detection method has a good tracking performance and can quickly track the dynamic changes of the load current.

3. Constant Frequency Integral Reset Control Active Power Filter

All kinds of APF detection and control methods are used to solve the problem. But because of the large amount of computation and high accuracy, the structure of active power filter is complex and the reliability is not high. Especially in the medium and small power occasions to promote the use of.

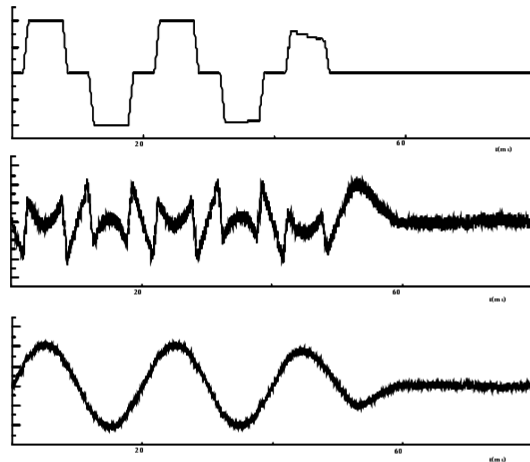


Figure 10 – Simulation Wave Form With the Load Current Decreased to Zero At one Cycle.Top: Load Current; Middle: APF Current; Bottom:Load Current

3.1. Apf Constant Frequency Integral Reset Control Method

The control objective of active power filter is to provide the required harmonic and reactive current, so that the source can provide sinusoidal active current to the nonlinear load. The equivalent circuit can be seen as an equivalent linear resistor load R_e , as shown in Fig.11.

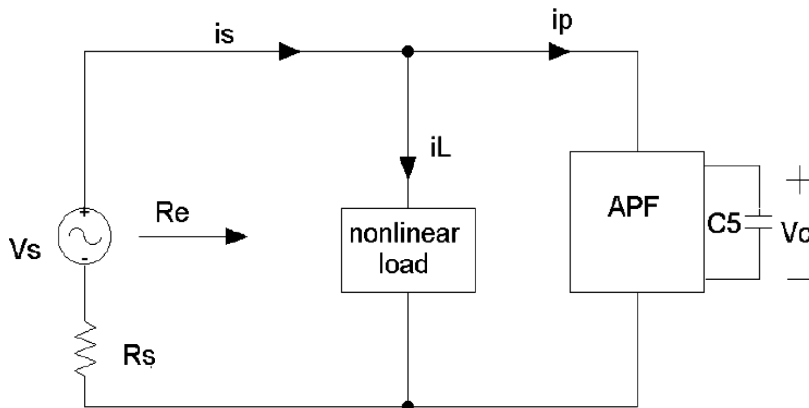


Figure 11 – Equivalent Circuit of APF and Nonlinear Load in Parallel Connection

From Fig.11,

$$V_s = R_e \cdot i_s \quad (12)$$

Wherein, R_e for the APF and the nonlinear load parallel, from the grid side to see the equivalent resistance. APF power inverter circuit with the transfer voltage ratio

$$M(d) = \frac{v_c}{v_s} = \frac{A(d)}{B(d)} \quad (13)$$

Wherein, D is the variable power inverter circuit in the duty ratio of the switch, $M(d)$ $A(d)$ and the molecular denominator of $B(d)$ is a polynomial of d finishing

$$B(d)v_c - A(d)R_e \cdot i_s = 0 \quad (14)$$

By the following formula, the APF and the nonlinear load are connected in parallel, and the form of the control objective equation is $d(s)$ polynomial. Therefore, it is possible to control the APF by using the integral reset method. The problem of Guan Jian is to derive the specific form of the APF power inverter $M(d)$, and how to deal with the equivalent resistance R_e .

3.2. Apf Power Level Model

In order to derive the specific form of the APF power inverter circuit transfer voltage ratio $M(d)$. Firstly, the power level model of active power filter is considered, and the circuit is shown in Fig.12. The nonlinear load can be composed of multiple loads. The power level of the APF is composed of a H bridge and an energy storage capacitor C and a filter inductor L_2 . As an active power filter, the H bridge is a bidirectional converter, which is a voltage type inverter, and the energy of the DC side of the converter is transformed to the AC side. On the other hand, from the AC side to the side, the H bridge can be considered as a dual Boost converter. The main circuit of the H bridge is to provide the load required by reactive power and harmonic current to make the nonlinear load from the power source to absorb the active current. In order to derive the power level model, the hypothesis is assumed:

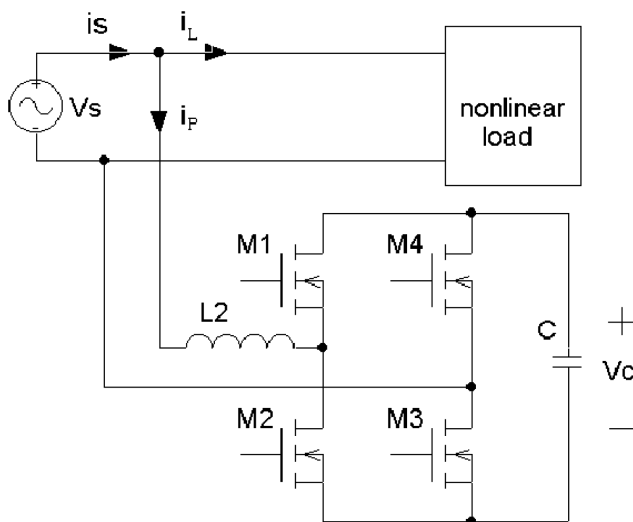


Figure 12 – Single-Phase APF and Nonlinear Load in Parallel Connection

1. in order to achieve a good compensation performance, the voltage of the energy storage capacitor is higher than that of the AC line voltage $v_c > V_{sm}$;
2. the switching frequency of the H bridge f_s is much higher than that of the AC power supply, $f_s \gg f$;
3. H bridge works in two state modulation, in each switch cycle of memory in two kinds of switch operating state (in $0 < t < dT_s$, M1, M3 located. M2, M4 opened, $T_s = 1 / f_s$ for switching cycle);
4. the energy storage capacitor is large enough so that the voltage on the capacitor can be considered as constant in a switching period. According to the above hypothesis, the equivalent circuit of $0 < t < dT_s$ and $dT_s < t < T_s$ is shown in Fig.13.

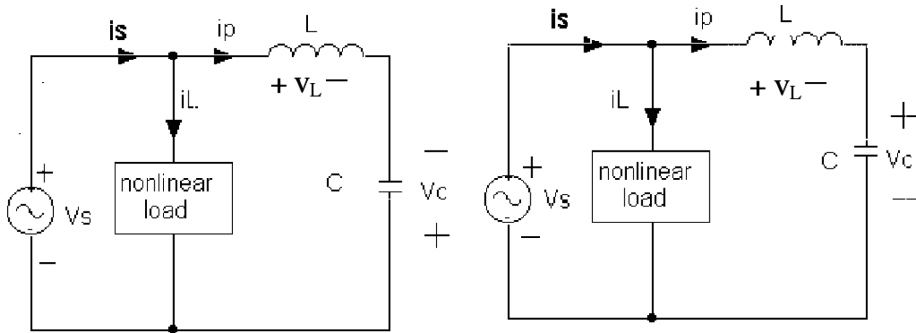


Figure 13 – Equivalent Circuit of APF Power Stage

Which can be seen from the picture, in the M_2, M_4 conduction period. In period $0 < t < dT_s$, the voltage across the inductor:

$$v_L = v_s + v_c \quad (15)$$

According to hypothesis 1), due to the $v_c > v_s$, so whether the upper v_s is greater than zero (Positive half wave) or less than zero (Negative half wave) $v_L > 0$. Similarly, in the M_2, M_4 , during the $dT_s < t < T_s$ period, the voltage across the inductor:

$$v_L = v_s - v_c = -(v_c - v_s) \quad (16)$$

Similarly, both positive and negative half wave, there are $v_L < 0$ or $(v_c - v_s) > 0$. At the steady state, the voltage across the inductor must satisfy the equation of the volt second:

$$(v_s + v_c)dT_s = (v_c - v_s)(1-d)T_s \quad (17)$$

So the relationship between the energy storage capacitor voltage and the power supply voltage can be obtained.

$$v_c = \frac{1}{1-2d} v_s \quad (18)$$

When v_s is greater than zero, $d < 1/2$, when v_s is less than zero in the negative half wave $d > 1/2$, so the positive half wave and the negative half wave of v_s are set up.

3.3. Constant Frequency Integral Reset Control Apf (Cfirc-Apf)

In order to derive the specific objective equation of the constant frequency integral reset control APF, the transfer voltage ratio of APF can be derived from the formula 18:

$$M(d) = \frac{v_c}{v_s} = \frac{1}{1-2d} \quad (19)$$

At this time, $A(d)=1$, $B(d)=1-2d$,

$$(1-2d)v_c = R_e i_s \quad (20)$$

Taking into account the effect of the current sampling resistor R_s , the equations are simultaneously multiplied by the sampling resistor R_s , and sorted.

$$2dv_m = v_m - R_s I_s \quad (21)$$

Wherein,

$$V_m = \frac{R_s}{R_e} V_c \quad (22)$$

Formula 21 is the control objective equation of constant frequency integral reset control APF, where R_e is the equivalent resistance of nonlinear load power consumption, and the unknown quantity is changed with the load. But through the analysis of the change of R_e can be determined by detecting the change of the voltage on the storage capacitor. Because the active power filter is provided with the reactive power and harmonic current without considering the loss in the steady state operation, no active current flows into the active power filter. By the power balance, in the steady state, the equivalent input resistance R_e is constant when the capacitor voltage is constant. If the active current changes in the load current, that is, the equivalent resistance R_e changes, resulting in the power supply of the fundamental active current and load current in the fundamental active current. So, there will be provided by the power supply part of the active current into the APF, this part of the active current of active power in APF energystorage capacitor voltage changes. If the active current component of $i_L(t)$ is reduced, there is a partial active power flowing into the APF, which leads to an increase of the capacitance voltage. On the other hand, the capacitor voltage is reduced. In this way, we can obtain the information of the R_e change, and the v_m of the formula 22 can be obtained by detecting the variation of the capacitance voltage. After the target equation of constant frequency

integral reduction control, the target formule 21 is defined to determine the duty cycle, so that the input current of the input current is controlled by the power supply voltage, which is the same frequency and phase of the power supply voltage. According to the previous analysis, a new structure of active power filter based on constant frequency integral reset control (CFIRC) is presented in this paper.

In Fig.14 control circuit by the error amplifier, PI regulator, belt reset integrator, comparator, clock and a trigger. The operating principle is: the capacitor voltage is detected, and a reference voltage v_{ref} is compared, and the error signal is adjusted by a PI regulator, which is used as the v_m in equation 21, which reflects the change of the load equivalent resistance R_e and also maintains the stability of the capacitor voltage. Then the v_m was sent to an integrator reset switch, due to the assumption 2), v_m in one switching cycle energy is approximated recognition remains unchanged, so:

$$\frac{1}{T_i} \int_0^{dT_s} v_m dt = \frac{1}{T_i} dT_s v_m \quad (23)$$

Wherein, T_i is the integral constant, the integrator order $T_i = \frac{1}{2} T_s$, there are:

$$\frac{1}{T_i} \int_0^{dT_s} v_m dt = \frac{1}{T_i} dT_s v_m = 2dv_m \quad (24)$$

This will achieve the control target equation formula 21 left. In Fig.13 when the clock pulse arrives M_1 , M_4 was opened, the integrator to the integration of the error voltage v_m , the output of the integrator in the comparator input terminal and $(v_m - R_s i_s)$ compared. When the v_m integral value reached $(v_m - R_s i_s)$, comparator outputs change state and trigger R_s flip-flop, flip flops, off M_1 , M_4 , M_2 and M_3 opened, and the reset switch, make the integrator reset, waiting for the next clock pulse arrives, and then start the integral. This process repeats within each switch cycle. This control objective formule 21 is satisfied in every switching period. APF function is achieved.

4. Experimental Study on Active Power Filter With Constant Frequency Integral Reset Control

In order to test the actual compensation performance of the proposed APF, the author designed, installed and debugged the experimental prototype of the single phase APF with the method of constant frequency integral control. The circuit diagram of the circuit is shown in Fig.14. The technical index of the prototype is:

Power supply voltage: AC 110 V.

Power frequency: 60Hz (American power grid).

Output power: 500W.

The power main circuit is composed of 4 single phase inverter bridge with power field effect tube 40kHz and the switching frequency is 1RF460. Due to the high switching frequency, and the switch speed of the MOSFET body diode is not required, each

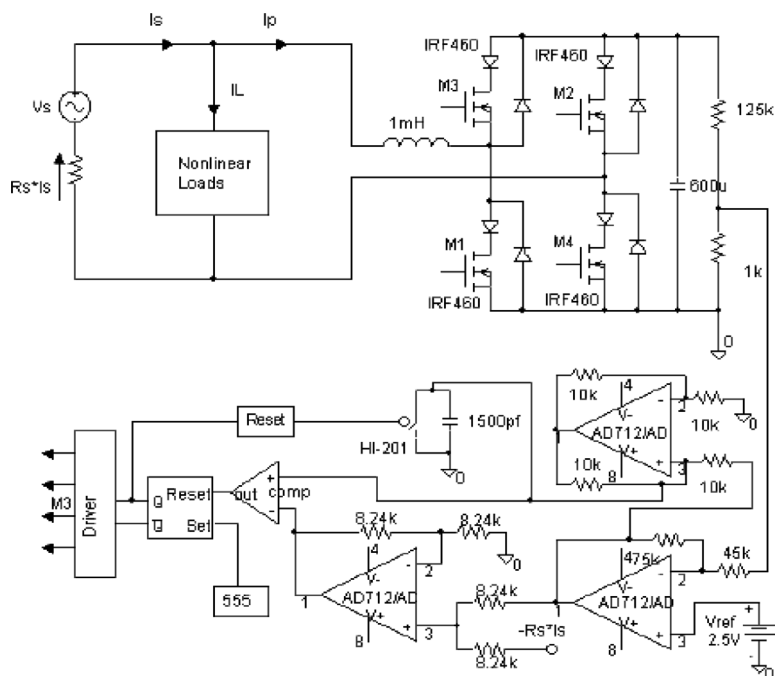
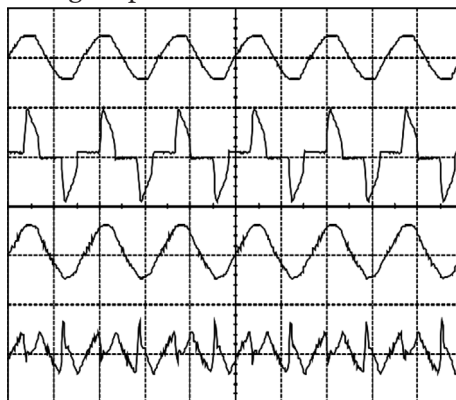


Figure 14 – Experimental Circuit of APF Based on CFIRC

MOSFET tube is connected in series with a Schottky diode to block its body diode, and an ultra fast recovery diode MUR3040 as a continued flow diode.

In order to test the performance of the experimental prototype, three typical nonlinear loads are used to test the performance of its tracking and compensation. In Fig.15, the current waveform for the completion of the prototype in compensation for a common diode bridge rectifier with large capacitor filter. The waveforms from top to bottom are



the power supply voltage, the nonlinear load current, the compensation current of the power supply and the output of the CFIRCAPF prototype. Can be seen from the waveform

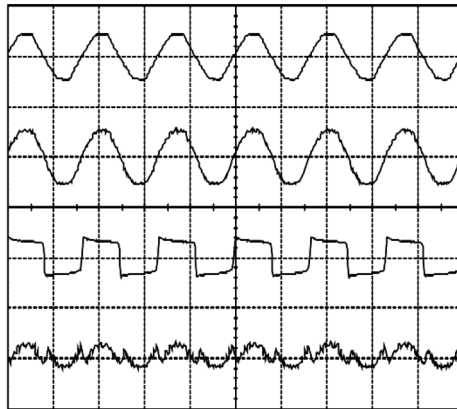


Figure 16 – Experimental Wave Forms of CFIRCAPF Compensating Diode Rectifier with RL Load(10ms/div ;5A/div)

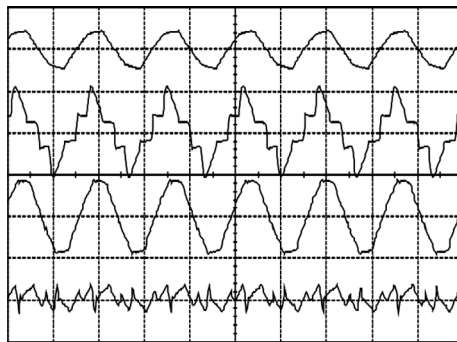
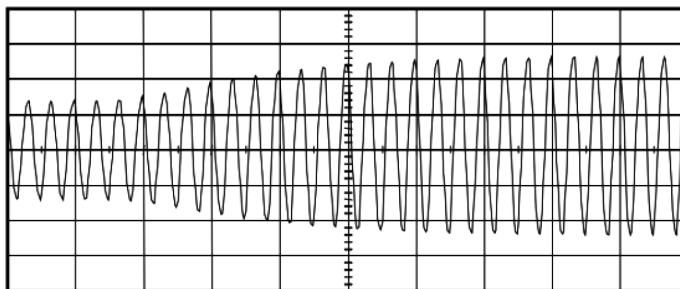


Figure 17 – Experimental Wave Forms of CFIRCAPF Compensating Diode Rectifier with RL and RC Load(10ms/div ;5A/div)

Figure 15 – Experimental Wave Forms of CFIRCAPF Compensating Diode Rectifier with RC Load(10ms/div ; 5A/div)

Commonly used diode rectifier to increase the capacitance of the filter (filter capacitor in the experiment, $1000\mu F / 400V$), the load current of the DC rectifier from the grid to draw a sharp pulse wave, not only contains a large number of harmonics, but also very low power factor. Total harmonic distortion rate (TotalHarmonicDistortion) of nonlinear load current THD=79.447%. After the compensation of APF, the power supply current of THD is reduced to THD=8.24%. In Fig.16 here is a CFIRCAPF compensation for a diode rectifier bridge with a large inductance filter (RL load $L=300mH$) when the waveform. The waveforms from top to bottom are the power supply voltage, the power supply current, the nonlinear load current, the output of the APF model, and the compensation current of the APF. Because of the flat wave action of the large inductance, the load from the power grid is Fang Bo, with a large number of harmonics, THD=45.33%. After the compensation of APF, the power supply current of THD is reduced to 6.893%, which is consistent with the supply voltage.

Fig.17 for the APF at the same time to compensate for the above two kinds of nonlinear load current waveform. From the diagram, the total load current is two kinds of nonlinear load current, the harmonic current of the two kinds of nonlinear loads have a certain degree of mutual compensation, and the total nonlinear load current THD dropped to 35.73%. But still contains a large number of harmonics through the APF compensation, the grid current THD to 5.99%. Since CFIRCAPF is the waveform of the current tracking network voltage after compensation, from the experimental waveforms, we can see that there is a certain distortion of the grid voltage, the voltage distortion rate of the



THD=3.9%. So if the power grid voltage waveform is pure sinusoidal current THD should be less than the measured THD value.

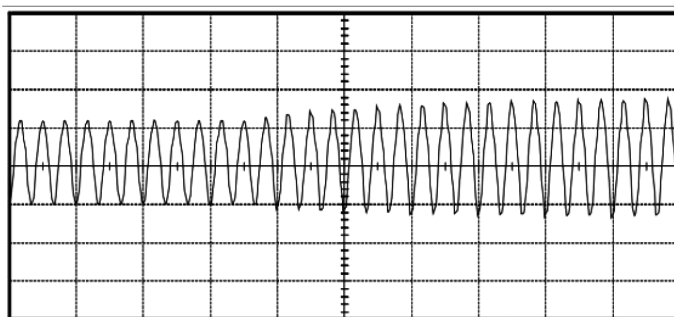


Figure 18 – Experimental Line Current Wave Forms of Diode Rectifier With RC Loads(
 $C = 1000\mu F$ and R stepped from 225Ω to 100Ω)

Figure 19 – Experimental Line Current Wave Forms of Diode Rectifier with RL Loads
($L=300mH$ and R stepped from 120Ω to 60Ω)

In order to test the tracking of the load current of the APF, the author also carried out experiments on the dynamic compensation performance of the diode rectifier bridge under the APF load and RL load in two cases. In Figure 18 the RC load ($C = 1000\mu F$) of the rectifier bridge is R from 225Ω to 100Ω when the power supply current is compensated by APF. Figure 19 for the rectifier bridge with RL load ($L=300mH$), when the resistance from 120Ω suddenly changed to 60Ω , the APF compensation for the future of the power supply current waveform. The experimental waveforms show that the APF can compensate for the periodic harmonic current in the process of the steady state. In the transient process, it also has good compensation characteristics. At the same time, the completion of the APF on the load current step change has a very good smoothing

filter role, can reduce the impact of load mutations on the grid, which is very useful for the power grid. Through the analysis of the experimental results, the following conclusions can be drawn:

1. in the case of different nonlinear load current, the proposed integral reset control APF, can make the power supply current waveform and voltage waveform remain consistent, basically as a sine wave. Regardless of is the bridge rectifier with RC load, or RL load, or a plurality of nonlinear load, after the completion of APF compensation, power from the end look into it as a linear resistive load, thereby eliminating the inflow of power grid harmonic and reactive current, and anterior theory analysis of exactly the same.
2. in parallel to a nonlinear load of APF, the harmonic and reactive currents required to provide the load are only required. Without having to deal with fundamental current. As can be seen from the experimental waveforms, the rectifier bridge with RC load, although the load power is not big, but the THD. While the load output of the load is the largest, the power of the load is the largest, but the harmonic and reactive current are reduced due to the load, and the compensation current of APF is minimum.
3. through the load step change experiments can be seen, because the change of the compensation current is reflected by the power balance of the DC side of the APF. The DC side capacitance is very large, and the change of the voltage is very slow, so when the load step change, APF is equivalent to a smooth filter. This reduces the impact on the power grid. In addition, in the power supply current of the transient waveform, the current has been able to guarantee for the sinusoidal, but the magnitude of the change. This shows that the APF not only has a good steady-state compensation characteristics, but also has a good transient compensation performance.

5. Conclusions

Active power filter technology, as an effective method to restrain power harmonics and improve power supply quality, has received much attention in recent years. Detection and control of distortion current in active power filter is the key factor to decide the compensation performance of active power filter. At the same time, it also affects the application of APF in modern power system. Therefore, the new method of harmonic detection and control could improve the accuracy and speed and further improve the compensation performance. In order to adapt to the modern power system, the structure of the multi - variable simplified system, the cost reduction and improvement of the reliability have important theoretical and practical significance.

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