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*Research Article*

# Explore on Online English Listening Evaluation System Using the Genetic Algorithm

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Testing is a good teaching tool. The online testing system can realize automatic aggregation, scoring, statistics, and analysis of test questions, which saves a lot of time and money for the organizers and participants, and is an effective means to promote the modernization of education in China. The purpose of implementing English intelligence is to allow teachers and students to make better use of their strengths in the English learning process and to improve English teaching based on the results of quantitative analysis of intelligence, which will play a positive role in promoting quality language education in secondary schools, thus truly reducing the burden on teachers and students. The genetic algorithm is an intelligent algorithm based on natural selection and genetic variation in the world of bionic organisms. It has the remarkable advantages of simplicity and generality, robustness, parallel processing, efficiency, and practicality, and has been widely used in automation and other fields with good results. The method can effectively overcome the traditional problems of slow grouping speed, low success rate, and poor grouping quality. The system is scientific, reasonable, and practical and can meet the needs of users to the maximum extent.

## 1. Introduction

*1.1. The Use of Genetic Algorithms in Computers.* With the rapid development of computer technology and network technology, people have become more aware of this [1]. Most colleges and universities are connected to the Internet and have established networks on their campuses. The hardware equipment is getting better and better. Internet online examination has the characteristics of cross-territory, working anytime, working anywhere, and having a wide range of users, which is an important way to promote the modernization of education in China. It has become an important way to promote the modernization process of education in China [2]. It has become an important tool in practice, testing, evaluation, and analysis. In teaching, examination is a very important part. It is an important method to measure and evaluate the quality of education. It should also be integrated with modern information technology. Traditional essay-based quizzes, manual questioning, answering, manual reading, manual statistical results, and paper analysis can no longer meet the requirements of modern education. Online examination system can realize automatic question issuance, online examination, remote monitoring, automatic reading, and automatic statistical analysis, which optimizes the examination mode, greatly saves the time and cost of examination organizers and participants, and has important practical significance for improving the efficiency of school operation and promoting education modernization. These years, there are already some electronic testing systems that use computer and Internet technologies that have come into existence. However, all these methods have some defects as follows: on the basis of the C/S model, special clients need to be installed and it is difficult to update them [3]; only manual and randomized services are available, so the quality of the package is low and slow; the quality of group questions is poor, so the efficiency of the questions is low and the IQ is poor; only the automatic scoring function of objective questions is available, so the scoring of fill-in-the-blank and other subjective questions cannot be done automatically, and the security is low.

*1.2. Concept of the Genetic Algorithm.* As we know, genetic algorithms deal with binary chromosome encoding through encoding techniques that mimic the evolutionary process of binary string populations. The algorithm generates a new generation of binary strings, i.e., well-tuned segments and bits in each generation with the help of good genes from the previous generation [4]. Compared to traditional random methods, this method efficiently uses the available information to find characters with improved performance, a process similar to natural evolution, which in essence improves the chances of inheritance of its genes by screening for high quality chromosomes. In the solution space, the global optimal solution is found by iteration, as shown in Figure 1. The iteration of the population consists of three main operations: selection, hybridization, and mutation. The genetic algorithm is a kind of bionic optimization algorithm, which is a kind of knowledge obtained from human's own evolutionary process, that is, an intelligent algorithm that can imitate the continuous evolution of biological populations in nature. First, the optimization goal is approached gradually through steps such as selection, hybridization, and mutation.

## 2. State of the Art

*2.1. Current Status of Domestic and International Research on Heritage Algorithms.* Foreign countries have researched fast and efficient online examination systems, especially new distance learning software that not only achieves better interactivity and high efficiency of the system but also better functional extensions with the system by designing and implementing the latest system that enables real-time data transfer under the Internet for learners to achieve real-time on-demand and learning. As the global competition for talents has been fierce, in today's competitive society, most countries in the world are trying to develop online education to gain a dominant position in the education field so that Internet technology can be widely used in the education industry [5]. Since the birth of Internet technology, it has a series of advantages such as interactivity, sharing, wide distribution, and free and open access, which are more beneficial to the education industry and can save the cost of education; thus, today, online real-time exams are becoming more and more popular.

Most universities in China now have their own standalone or introduced online testing systems, as well as many other types of data support, talent assessment and recruitment, and education. The company has also developed its own sophisticated online testing system. Currently, in the past two years, the Ministry of Education's computer grade exams, Mandarin proficiency exams, and some professional certification exams from the Ministry of Human Resources and Social Security have been implemented online [6]. Currently, domestic online test systems are catching up with foreign development levels and conducting in-depth research in the direction of intelligence in terms of test question extraction, machine reading scope and test data mining. At present, many professional and technical examinations in the form of online web-based examinations exhibit the following characteristics, as shown in Table 1.

*2.2. Application of the Genetic Algorithm.* The genetic algorithm is an intelligent algorithm. In the previous section, the concept of genetic algorithm as well as the steps and key techniques of the algorithm are introduced in detail [7]. In the next paper, we use the genetic algorithm to implement automatic grouping of test libraries. There are many kinds of chromosome encoding, and binary encoding is the most common one. The biggest drawback of binary encoding is that it has a long encoding length and a large retrieval space. To address this problem, a packet-based natural number encoding method is proposed to reduce the total number of iterations and speed up the solving speed. Packetization implies that each packet represents one type of problem, and natural number encoding implies that the individuals in each problem are encoded in the form of natural numbers. For better understanding, an example is given in Table 2. This study assumes that there are three types of questions to be written: multiple-choice, fill-in-the-blank, and parsing questions, and Table 2 shows the chromosomes for the latter two topics grouped by group natural number coding.

*2.3. General System Overview.* The English intelligent diagnosis system is a computerized intelligent teaching, diagnosis, testing, and feedback system [8]. It is built on the basis of a sound knowledge structure system and a large question bank. After deep data mining of the question database, it uses four engines of test paper generation, assessment, diagnosis, and intelligent learning to complete a number of system functions such as thematic integrated practice, individual test and class test assessment, individual diagnosis, and class diagnosis, and provides them to users in web form. The basic block diagram of the system platform is shown in Figure 2.

The English online test management module is a key part of the English test [9]. The cloud-based English test system needs to be designed to address different test requirements and to process different test instructions in real time for different test sizes and requirements. The test system also needs to provide test resource sharing, support for cloud-based management, and other functions, and be managed by specialized technical staff to accommodate dynamic storage requirements. With the English online test management module, question writers can store all their test resources at any time and can call test resources at any time according to different test requirements. Candidates log into the system before the exam to complete the questions, and the answer time is automatically recorded and saved in real time; after the answers are completed, the relevant data is sent to the system [10]. The huge cloud storage space ensures that the stored data will not be damaged or lost.

*2.4. System Structure and Functional Design.* The ASP.NET online testing system is developed on a B/S basis [11]. Users can take online tests through the interaction between web browser and web server. The system is divided into three parts: system administrator, teacher, and student. The system administrator is responsible for the daily management and maintenance of the system. The main components are:
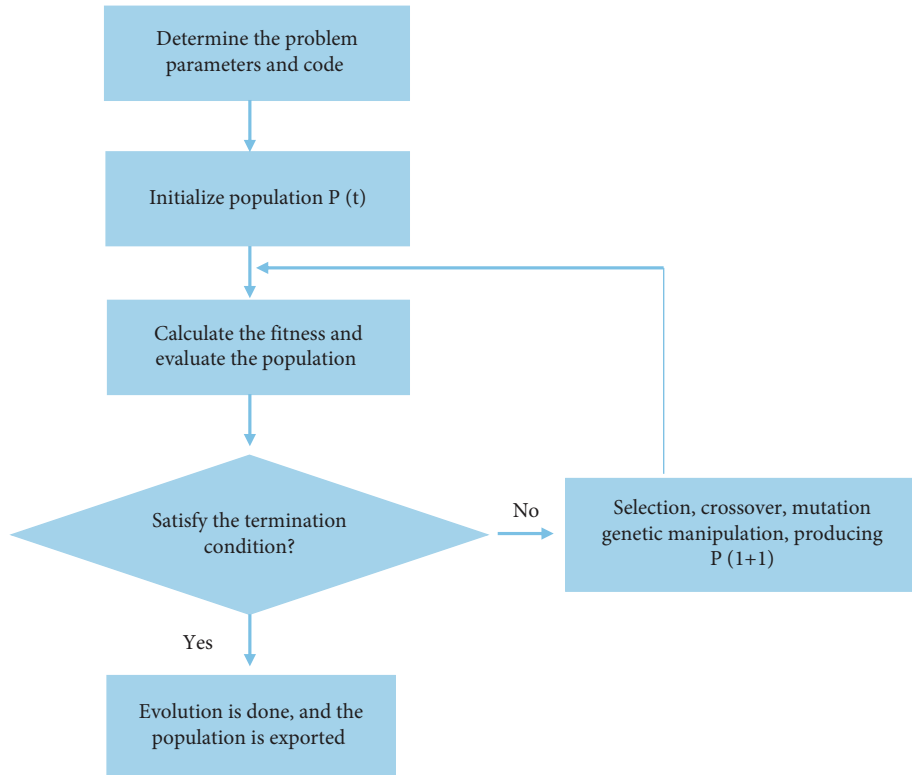
FIGURE 1: Schematic diagram of the operation process of genetic algorithm.

TABLE 1: The main types and characteristics of network testing.

| Test type | Test features |
|---|---|
| Open | Online public test has unlimited location and limited time |
| Semiopen | Proctored exams, where candidates take online tests on time and on location |

TABLE 2: Chromosome coding for both thesiss.

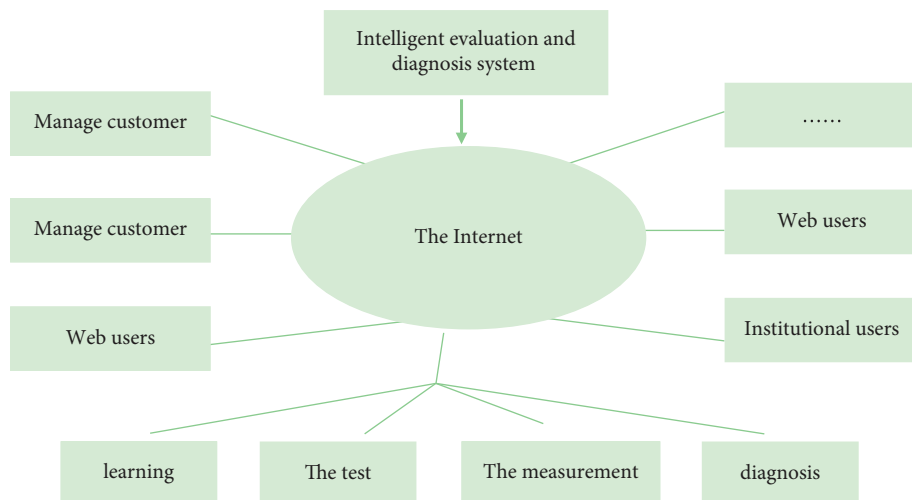| | Multiple choice questions | | | | Fill-in-the-blank questions | | | | Analytical questions | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Test thesis 1 | 20 | 31 | 1 | 64 | 24 | 2 | 68 | 7 | 5 | 91 | 37 | 68 |
| Test thesis 2 | 4 | 90 | 67 | 45 | 56 | 99 | 35 | 57 | 74 | 8 | 10 | 27 |



FIGURE 2: System basic framework diagram.

managing the database, maintaining the information of teachers and test takers, and managing the security of the system. The teachers are responsible for setting and maintaining the question bank, determining the parameters of the papers, distributing the test questions, scoring the subjective questions, and querying and analyzing the data. The students take the online quizzes and check their scores. The system consists of a user management sub-system, question bank management sub-system, essay writing sub-system, online examination sub-system, marking and scoring sub-system, score query sub-system, and statistical analysis sub-system.

The C/S model does not require intermediate links to connect the client directly to the server, so the response time is very fast; in addition, the C/S model has a friendly interface and strong transaction processing capability, and can complete a variety of complex business processes, see Figure 3. The biggest advantage of the B/S model is that it can work at any location without installing special software. As long as there is a computer with Internet access, the system can be easily expanded without any client maintenance [12]. As long as there is access to the Internet, the username and password are specified by the administrator, and it can be used. Therefore, the C/S approach is used in both test bank and score management subsystems, which places higher demands on the interactive capability and security, stability, and efficiency of the testing system. This system is a B/S system, using IE browser to log in to the system for examinations, self-tests and personal score inquiries; using IE browser, it can realize inquiries, analysis, and manual scoring of students' scores [13]. The system is based on test bank management and online testing and adopts a hybrid model architecture of B/S and C/S. The three levels of the testing system are shown in Figure 4.

## 3. Methodology

### 3.1. Intelligent Teaching Platform.

Intelligent teaching platform is based on network practice technology, using computers as a teaching platform to assist teachers and students in teaching and making the teaching process more intelligent. In the teaching process, the intelligent teaching platform replaces the teaching work that teachers had to complete in the past and establishes an intellectual and collaborative partnership that can meet different course characteristics and different student groups [14]. Currently, in English teaching, the intelligent teaching platform breaks the traditional teaching method, changes the interaction between teachers and students, and realizes multimodal communication between teachers and students and between students, realizing real-time and non-real-time communication. In addition, it has many advantages [15]. First of all, it can build a speech recognition system that can help learners with speaking training. In traditional teaching, it is difficult for teachers to listen to each student's pronunciation, recitation, and meticulous evaluation of their spoken language one by one. However, the intelligent teaching platform is able to break this limitation by enabling the correction of errors and the ability to repeat the training according to the correct pronunciation. Secondly, through the smart teaching

platform, targeted learning programs are designed to meet the needs and requirements of different students, thus achieving better results. It breaks through the limitations of time and energy of traditional classroom teaching, which prevented teachers from observing their classmates, much less each student in detail. With the development of society and the rapid development of science and technology, education must keep pace with the times, conform to the development of science and technology, use intelligent teaching platforms to guide students, and make the classroom more attractive, making it more efficient and nice.

In computerized online examinations, the design of the algorithm for drawing questions directly determines the efficiency and quality of the automatic set of papers. This paper focuses on a solution method that quickly and efficiently selects a set of optimal solutions, or a set of closest to optimal solutions, from a class of problems. Previous quiz systems have been implemented by random selection and inverse testing. The random selection method uses control indicators in the state space to randomly select a copy of the questions from the computer and place them in the test bank. This algorithm is simple in construction and fast in the extraction operation of a single question, but in the case of complex grouping conditions, it often leads to failure of the grouping due to local satisfaction of constraints. Therefore, this method is only applicable to the case of small question bank system with few constraints [16]. This system uses genetic algorithm as the main algorithm and has the advantages of adaptive optimization and intelligent search. It is widely used. The combined genetic algorithm with the genetic algorithmapplied the method to the neural network and obtained better results: the convergence of genetic algorithm under the condition of maintaining optimality was widely studied. After theoretical derivation and practical application, it is proved that the method has good optimization performance and convergence performance.

### 3.2. Ajax Technology.

Ajax is not a language; it is simply a set of technologies that can be used to describe a set of techniques to improve the performance of the Internet. Ajax, whose full name is Asynchronous JavaScript, XML (XSTL), incorporates JavaScript scripting language, XHTML language, DOM documents, XML, CSS style sheets, XSTL, and several other technologies that play a role in collaboration. Ajax, Asynchronous JavaScript, XML, is a way of developing Web applications that uses client scripting to exchange data with a Web server. Ajax allows you to dynamically update pages without affecting the flow of interaction. The Ajax pattern introduces Ajax technology between the user and the server, which is like adding a layer of mechanism to the program to make it more responsive. When an action is performed on the interface, the web application pattern triggers a request for a connection to the server, which accesses the source, responds to the processing, and returns to the job execution interface. While the server is running, other client requests must wait, which wastes time and causes unreasonable resource allocation. Ajax technology uses
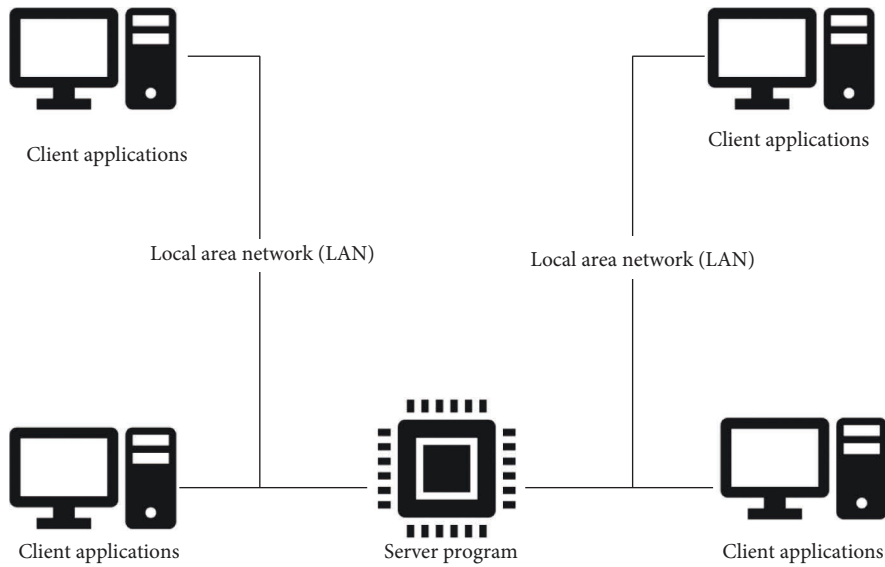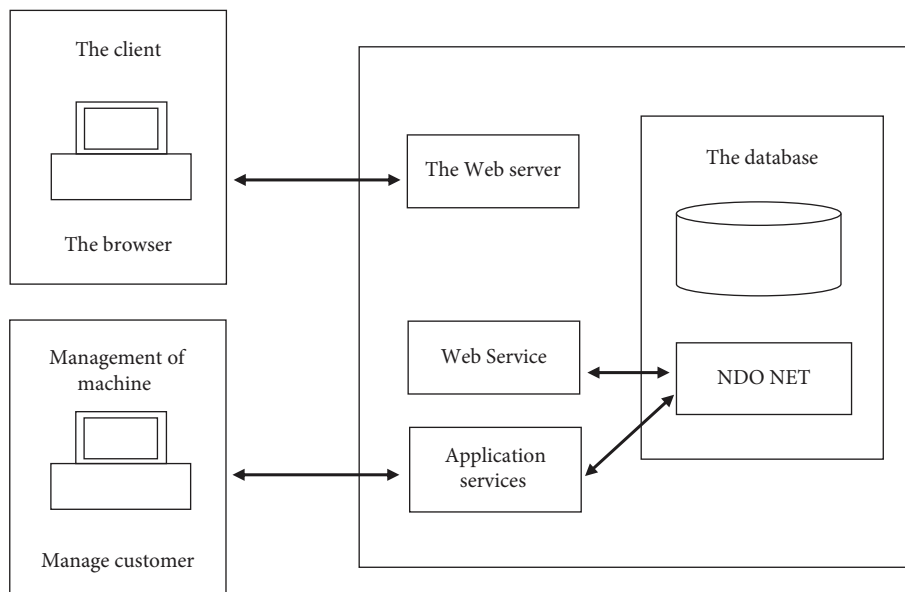
FIGURE 3: C/S mode of online examination system.



FIGURE 4: Examination system three—layer architecture.

asynchronous data exchange to enable user program interaction without waiting for server-side communication, helping users to save waiting time and improve the efficiency of program operation. Figure 5 shows a comparison diagram between the ajax model and the traditional Web workaround. Figure 5 shows the ajax model.

*3.3. Theoretical Basis of Test Bank Construction.* A test bank is simply a set of different exam questions. The test bank is set up with certain requirements for the test questions [17]. If all the questions can be entered into the test bank, then even if there is a question bank, this question bank is meaningless. In the development of educational econometrics, the construction of the test bank should be both theoretically based and index-constrained. The constraint of test questions in the test bank is the indicator constraint in the theory of educational measurement. These indicators are quantitative statistics that can be calculated by corresponding methods, and we call these indicators item statistics (or item parameters). The design of the test bank is based on modern examination theory, and there are currently two main approaches, namely, the classical measurement theory and the item response theory.

The test question index system contains a set of parameters that provide a qualitative or quantitative description of the intrinsic and extrinsic properties of the test questions and their role in the examination system. The automatic assembly of articles and the establishment of the
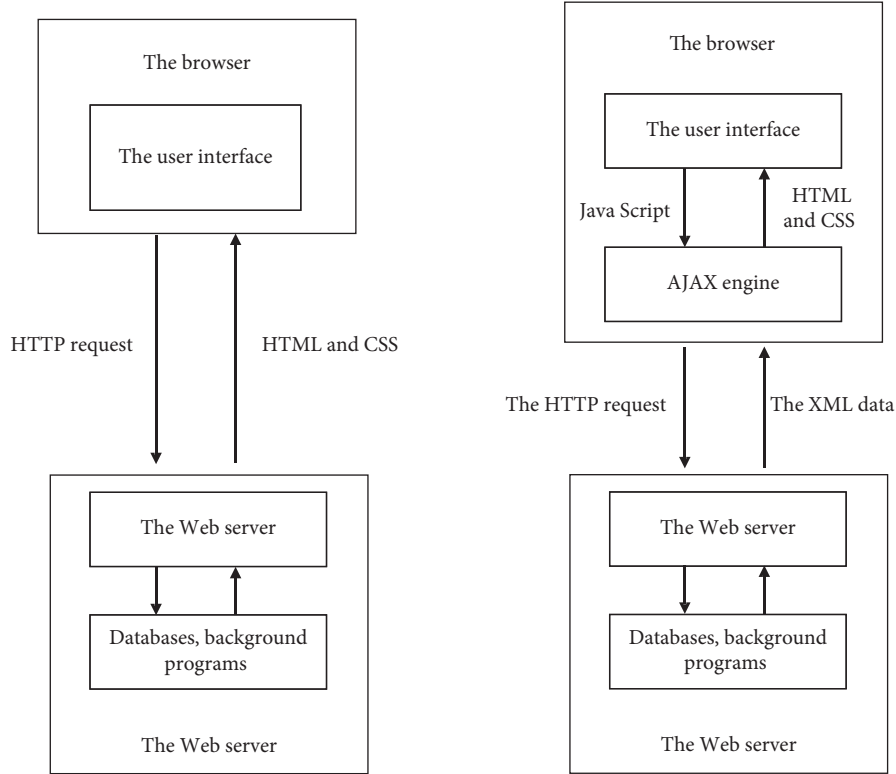
FIGURE 5: Diagram comparing the Ajax model to the traditional way the web works.

question bank management system are the prerequisites for the automatic assembly of test papers. The reasonableness of the parameters of the test indicator system directly affects the success or failure of group examinations. The test question indicator system defined in this article is: $C =$ {knowledge, question type, chapter, difficulty, variance, ability requirement, score, and exposure}. There are several test question indicators reflecting subject matter information that can be provided directly to the user or computer for easy adjustment of the subject matter and computer grouping of papers. Difficulty refers to the difficulty procedure of the test questions. There are various ways to determine the difficulty of a test question, and the formula for calculating the difficulty of an objective question is as follows:

$$
\begin{aligned}
P &= \frac{R}{N}, \\
f &= \sum_{i=1}^{t=5} f_i w_i, \\
f &= k_1 \times W_N + k_2 \times W_J + k_3 \times W_C + k_4 \times W_Q.
\end{aligned}
\tag{1}
$$

$P = 0$ means that all the questions had no correct answers and the question was very difficult. $p = 1$ means that all the students got it right and the questions were very difficult. Obviously, the difficulty index refers to passing the test. The higher the rate of passing is, the easier the problem, and vice versa,. The formula for calculating the difficulty of subjective questions is as follows:

$$
\begin{aligned}
P_i &= \frac{Xi}{K_i}, \\
E &= \frac{1}{\sum_{k=1}^{N} (T_k - Y_k)^2},
\end{aligned}
\tag{2}
$$

$P_i$ represents the difficulty level of the question, $X_i$ represents the average score of the question, and $K_i$ represents the full score of the question. The value of the difficulty index represents the degree of difficulty that is inversely proportional to the $P$ value relative to the degree of difficulty of the objective questions.

The difficulty of a test paper is usually required to be normally distributed in order for the test paper to be of test value. For questions with too high or too low difficulty, test papers are written with low variability, which is not conducive to the evaluation of teaching effectiveness. Based on the difficulty and score of each question in the test paper, the difficulty of the entire paper can be found by the following equation:

$$
\begin{aligned}
P(b_i) &= \frac{E_{b_i}}{E}, \\
P &= \frac{\sum_{i=1}^{n} P_i K_i}{\sum_{i=1}^{n} K_i},
\end{aligned}
\tag{3}
$$

where $P$ is the overall difficulty of the paper, $n$ is the number of questions included in the paper, $P_i$ is the difficulty of the $i$th question, and $K_i$ is the score of the $i$th question.

*3.4. Basic Overview of E-Rater Technology.* E-rater, developed by Educational Testing Service (ETS), is a hybrid scoring system with a modular structure. E-rater combines the advantages of PEG and IEA to provide fast and accurate diagnostic results. Table 3 summarizes the analytical focus, core technologies, and advantages and disadvantages of these three systems.

*3.5. ASP.NET Working Fundamentals.* ASP.NET, called Active Server Web, is based on the foundation of Web application development, and is Microsoft's software for implementing Web applications, an updated form of desktop applications. Implementing dynamic web pages is also a mainstream development technology. In practice, ASP.NET uses a very convenient programming environment in the writing process, which is very conducive to implementing dynamic web pages, and the combination of framework-based development and scripting files greatly facilitates the implementation process for developers, using COM components and other integrations in the system, which allows programmers to give greater autonomy, and the nested HTML code can be better written [18]. The nested HTML code can be used to better write interfaces and functions related to the WEB application, as shown in Figure 6.

*3.6. Implementation of the Online Examination System.* The system is based on the original online examination system; the design of the test bank and the analysis process of the intelligent paper formation algorithm are selected, and the combination of the test bank formation method and the paper formation algorithm is finally determined, with the aim of improving the quality of intelligent paper generation and the efficiency of paper release, and realizing the separation of teaching and examination in the state of school building, which is finally realized by the system [19]. The functional requirements of the whole system were determined through a comprehensive analysis of the internal survey and the actual situation facing teaching. Based on the functional requirements, we conducted feasibility analysis and auxiliary prototype system, and finally used ASP.NET development technology by comparing the existing auxiliary technology with the design and implementation part of the original system, while SQL Server 2008 was used for the database. The whole architecture was developed using mainstream B/S web application, and the home page was designed and developed using the latest HTML5 technology, combined with Ajax technology and JavaScript scripting language to achieve asynchronous transmission and page interaction. The combination of Ajax and JavaScript technology can largely solve the server load due to the large number of students using the system and reduce the waiting time. According to the system requirements and the problems implemented, the system development environment is shown in Table 4.

# 4. Result Analysis and Discussion

*4.1. System Requirements Analysis.* The online testing system based on the genetic algorithm should maintain the original testing functions on one hand, and further improve them on the other. The basic functions of the traditional test, such as issuing questions, assembling papers, taking exams, correcting questions, and summarizing. Improvements to traditional exams, such as adding some functions, improving on the basis of the original functions to make it more scientific. The online examination system based on the genetic algorithm should have the characteristics of abundant questions in the test bank, scientific and reasonable information formation, more comprehensive and scientific implementation, effective prevention of cheating, more accurate and thorough information analysis, easy to operate, easy to use, and can save a lot of human and material resources [20].

After a thorough study of the system and the work that needs to be done, this paper proposes the following points:

(1) Multirole user management: the system is logged in as administrator, teacher, and student. The administrator has higher privileges and can add, delete, and modify different users.

(2) Management of the test bank: the establishment of the test bank is the core of the whole online testing system, and the quality of its construction directly affects the overall operation of the system. In the construction of the test bank, various types of data forms should be established to manage various types of questions and set the difficulty, variance, burstiness, score, knowledge point, and question type of the questions, so as to classify them and improve them. The administrator of test bank can add, modify and delete test questions.

(3) Formation of papers: formation of papers should include two functions of automatic formation of papers and manual formation of papers, of which automatic formation of papers is the main one and manual formation of papers is supplementary and complementary to each other. Automatic grouping must use scientific and reasonable calculation methods to achieve the maximum demand for test papers, speed up the processing speed of test papers, and improve the quality of test papers. Manual grouping mainly artificially adjusts the test questions that do not meet the requirements manually, which improves the quality and scientificity of the test questions.

(4) Online test: the design requirements of the online test system mainly focus on the online test part. The online test should be able to cope with various unexpected situations in order to ensure the successful passing of the candidates. After registration, candidates must complete the test within the specified time limit, and to ensure the fairness of the test,

TABLE 3: Table of comparison of the three systems.

| System | Analysis of the key | The core technology | Advantages | Disadvantages |
|---|---|---|---|---|
| PEG | Language | 1. Statistical techniques 2. Natural language processing | Language quality analysis | 1. Not analyzing content 2. Only analyze the surface features of the text, which is easy to be recognized by examinees |
| IEA | Content | Information retrieval technology | Content quality analysis | 1. Not analyzing the language quality of the composition 2. No analysis of discourse structure |
| E-rater | Language content Chapter structure | 1. Statistical techniques 2. Natural language processing 3. Information retrieval technology | 1. More consistent with artificial scoring elements 2. Discourse structure analysis is included | 1. Poor analysis of content quality 2. The analysis of language quality is not comprehensive |
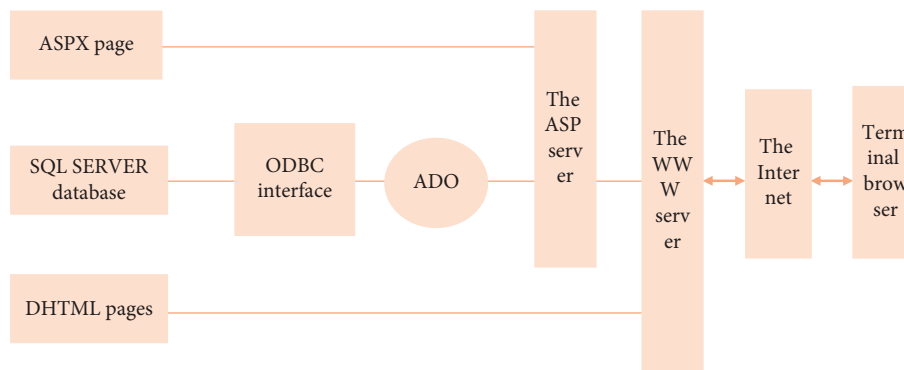


FIGURE 6: How ASP.NET works.

TABLE 4: System development environment requirements.

| Projects | Detailed description |
|---|---|
| Operating system | Windows 7/8/10 |
| Web server | IIS 7.0 |
| Browser | Mainstream browsers are fine |
| Database | Microsoft SQL Server2008 |
| ASP.NET | Microsoft NET framework 4.0 |
| Unit testing tools | Unit |

they must exit within the test time. In addition, to prevent cheating, the test should be supervised with the help of other auxiliary tools. The designed system data flow diagram is shown in Figure 7.

*4.2. System Performance Testing.* System performance testing aims to simulate the load capacity of the system under different load conditions in a given environment [21]. LoadRunner is a testing tool that can simulate a large number of users logging in and transmitting load at the same time to identify problems. Based on this, the relevant functions of the system were tested accordingly, and the test start clients were set to simulate the number of simultaneous logins of 700 and 2 seconds, respectively. The experimental results showed that the system had an average response time of 2.72 seconds and an average throughput of 48781.25 bytes, and are shown in Figure 8. During the test period, the data throughput of the system was basically stable except for

fluctuations at the beginning and end of the system, and the average response time of the system was stable at other times. The tests showed that some performance metrics (e.g., system throughput and average response time) met the expected user requirements.

*4.3. English Online Examination Management Module Design.* The English online test management module is a key part of the English online test system. The design of the cloud computing English online test requires the ability to receive and process different test requirements in real time according to different test scales and requirements, and to make real-time adjustments to the cloud server. It also requires the sharing of test resources and support for the functions of the cloud management system, which is managed by professional technicians to accommodate dynamic storage requirements. Management module for English online exams. The English online test management module allows test takers to save their test resources at any time, and different test takers can store and retrieve them at any time. Test takers log in to the system through authentication to answer questions, and the process will be automatically timed and saved in real time; when the test is over, the relevant data is sent to the system. The huge space of cloud storage ensures that the stored data will not be damaged or lost. The structure of the English online test management module is shown in Figure 9.
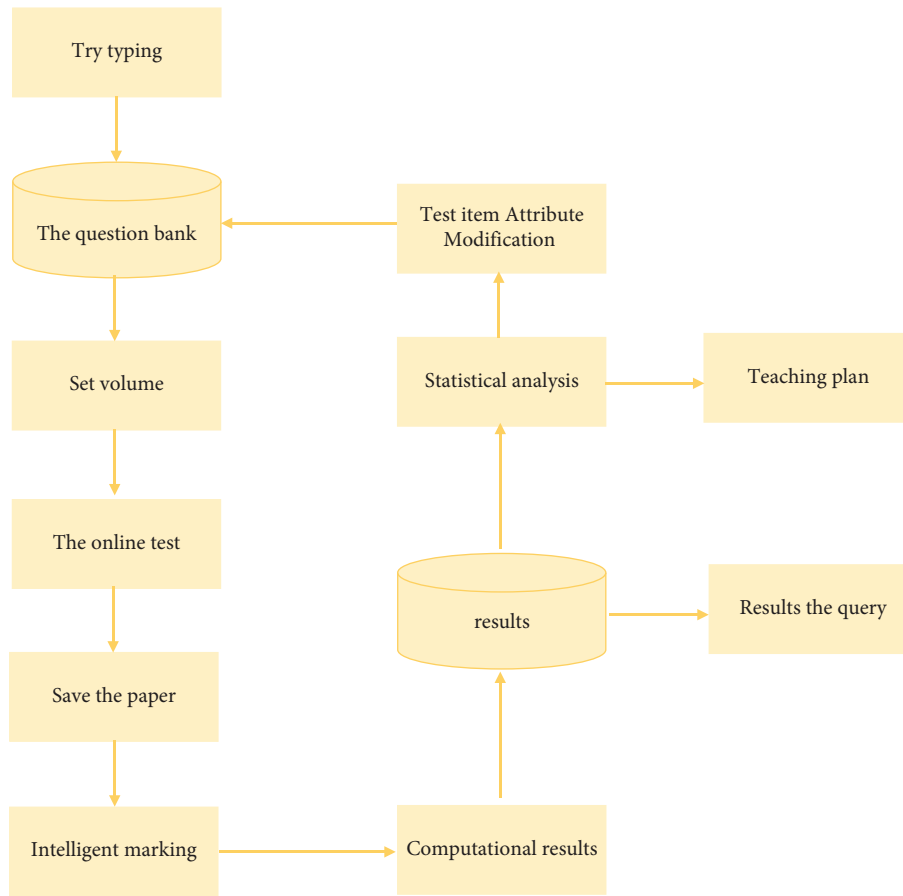
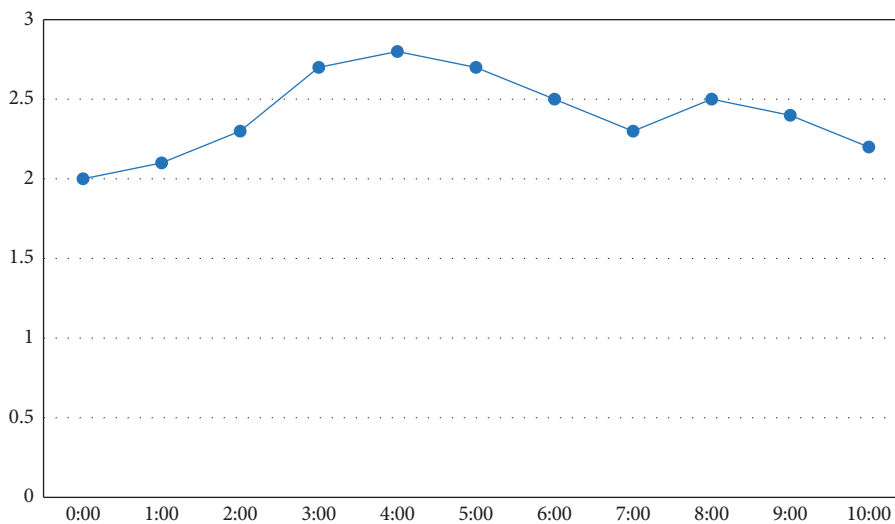FIGURE 7: Data flow chart of online examination system based on the genetic algorithm.



FIGURE 8: System response time diagram.

The English online test management module consists of paper grouping management, result management, test paper management, question bank management, the online test submodule, and the database value module. The paper management module can query, count, arrange, review, and print English online test questions; the web test subsystem can control the English online test, process monitoring, test paper storage, and other functions in real time, and use the database for data storage, backup, and recovery.
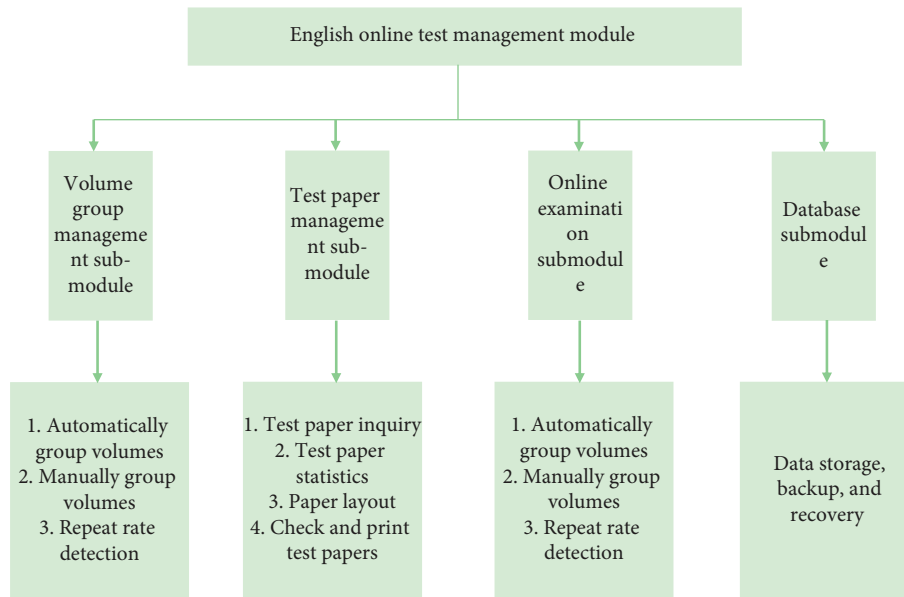
FIGURE 9: English online Examination management module structure diagram.

## 5. Conclusion

In this paper, firstly, we mainly analyze the current situation of online examination system, discuss the problem of insufficient intelligence of existing examination system, and design and implement a relatively intelligent and easy-to-implement online examination system based on the genetic algorithm. In the research and design of the whole system, the analysis focuses on the information grouping algorithm in the online examination system. Because of the good convergence of the genetic algorithm in the multi-constrained problem space, the system adopts a genetic algorithm based on the paper grouping algorithm. This paper first introduces the basic overview of the genetic algorithm, analyzes the constraint parameters to be used in the grouping model and the mathematical model of grouping, and then introduces the application of the genetic algorithm in the grouping algorithm strategy. Due to the limitation of the genetic algorithm itself, the basic genetic algorithm is integrated and designed with reference to the current relatively mature genetic algorithm and measures to reduce premature convergence during the design and implementation, and the finally the results are analyzed.

Development of English web-based teaching system. Through the establishment of this system, students will be able to conduct independent study and examinations, and obtain feedback information in time to make planned adjustments to the learning process and improve the teaching effectiveness. The next step is to conduct statistical analysis of the question bank and examination questions, and to analyze them to ensure the scientific and validity of the question bank, so as to improve the quality of the literature compilation and the effectiveness of online teaching.

## Data Availability

The labeled data set used to support the findings of this study is available from the corresponding author upon request.

## Conflicts of Interest

The author declares that there are no conflicts of interest.

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