# Design and Implementation of Distance Learning Platform Based on Information Technology and Cloud Computing

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***Abstract*—Distance learning is acquiring a role that becomes more and more important with the huge diffusion of the Internet and related technologies. This paper proposes a novel heuristic intelligent distance learning platform based on information technology and cloud computing. The proposed platform that are committed to accessibility assure that course designers understand the program's commitment to accessibility, have access to guidelines and resources. Experimental results show that the proposed platform can effectively improve the system throughput and reduce the execution time.**

***Index Terms*—Information Technology; Cloud Computing; Heuristic Intelligent Distance Learning Platform; Distance Learning; System Throughput**

## I. INTRODUCTION

Distance learning is when coursework occurs outside the standard classroom. Generally, professor and student are separated by geography [1, 2]. Coursework, lectures, class discussions, and testing is accomplished through a variety of media, including DVDs, Web Cams, Television and Radio broadcasts, and more. Also called: Distance Education, Online Education, Online Learning, etc. Distance learning is the use of computer technology and network communication technology for online learning process [3, 4]. Distance learning is not only breaking the traditional constraints of time, but also taking advantage of high-quality educational resources to maximize the development of the educational function, it is now also an important means of education in the future [5].

In 1892, the term "distance education" is first used in a pamphlet by the University of Wisconsin-Madison in the USA. In traditional distance education, teachers and students, students and students' communication has been a bottleneck restricting its development. The advent of cloud computing technology enables the development of distance education as opportunities [6, 7]. Teachers can pass through the network teaching information to students, the students learn to receive information via computer networking. In the learning process, students can be in various forms of communication through computer networks with teachers and classmates. Distance education is currently the most used Internet-based video technology and Internet technology, especially the use of the Internet asynchronous teaching, two-way interactive video instruction and one-way prerecorded video teaching technology [8, 9]. The specific needs faced by distance education, how to build reasonable and feasible distance education site architecture has become an important subject of current research various colleges and universities. Fig. 1 shows the Logical structure of distance learning platform.

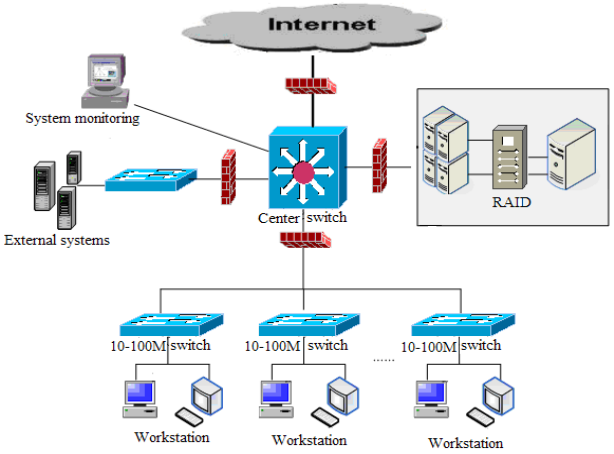


Figure 1. Logical structure of distance learning platform

In the domain of distance learning, the content development is an important stage of the design of teaching process. Indeed, the content is often regarded as an input parameter to an educational system. A student or instructor who is blind may use a computer equipped with text-to-speech software and a speech synthesizer [7, 8]. Basically, this system reads with a synthesized voice whatever text appears on the screen. He may use a text-only browser to navigate the World Wide Web or simply turn off the graphics-loading feature of a multi-media Web browser. He cannot interpret graphics unless text alternatives are provided [10]. For example, his speech system will simply say "image map" at the place where an image map would be displayed to someone using a multimedia Web browser. Printed materials, videotapes, and other visual materials also create access challenges for him [11, 12].A student who has limited vision can use special software to enlarge screen images. He may view


doi:10.4304/jnw.9.8.2059-2065

only a small portion of a web page at a time. Consequently, he is confused when web pages are cluttered and when page layout changes from page to page. Standard printed materials may also be inaccessible to him.

IT(Information Technology) is widely used in the world is not only a profound impact on the economic structure and economic efficiency, but as a representative of advanced productive forces [13, 14]. IT has caused traditional education is undergoing profound changes. Computer simulation technology, multimedia technology, virtual reality technology and distance education technology enables learners to overcome the barriers of space, more actively organize their study time and speed [15]. IT is the general term for a variety of technical management and processing of information used. It is mainly applied in computer science and communications technology to the design, development, installation and implementation of information systems and application software, including sensor technology, computer technology and communication technology [16]. IT education has two aspects meanings: The first refers to learn and master the educational information technology [17]. The second refers to the use of information technology for educational activities. IT education is through the study and application of information technology, information literacy training to achieve the theory and practice of learning and teaching optimization.

Distance education will open up global reach of knowledge dissemination channels to achieve learners in different regions, teach each other dialogues and exchanges between. Interactions quality is very important in the teaching process, requiring powerful and active scenarios of communication for the learner [18, 19]. Sometimes this requirement for quality imposes on the teachers a complete recasting of their courses and the manner in which they design them. Development of distance education will lead to a revolution in the traditional field of education, and promote a general increase in the level of human knowledge. The main features of information technology in education is in the process of teaching a more comprehensive use of computer and network communications based on modern information technology to promote comprehensive reform of the teaching process, so that schools can adapt to the new requirements of information technology in education [20]. Fig. 2 shows the distance learning platform workflow.

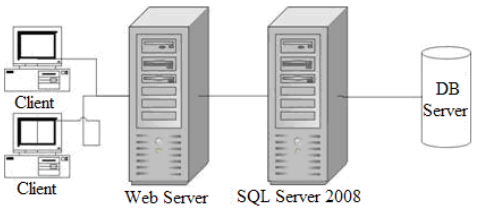


Figure 2. Distance learning platform workflow

In order to effectively solve the distance learning concurrent access conflicts, we proposes a novel heuristic intelligent distance learning (NHIDL) platform based on information technology and cloud computing. The proposed platform that are committed to accessibility assure that course designers understand the program's commitment to accessibility, have access to guidelines and resources. Experimental results show that the proposed platform can effectively improve the system throughput and reduce the execution time.

The rest of the paper is organized as follows. The optimization model of distance learning is proposed in Section 2. The proposed heuristic intelligent distance learning platform is introduced in detail in Section 3. In section 4 the proposed algorithm is evaluated and finally we conclude in Section 5.

## II. Optimization Model of Distance Learning

This section explores the construction of a personalized learning system based on B/S network mode. This paper presents a real-time interactive network teaching platform for a variety of terminal access to adapt to different teaching situations, which main contents include operating platform, real-time service platform and terminal services three subsystems. Teachers realize the modification of teaching resources, teaching strategies and student database repository, update and query operations through the client browser. Learning scheduling system achieve intelligent reasoning to determine the current students' learning progress and learning strategies [21]. Learning behavior collection module records the students to master knowledge of the situation, so that the system can correctly grasp the student's level of understanding, diagnosis of errors, thereby providing effective teaching materials [22]. Fig. 3 shows the system architecture of cloud computing platform.

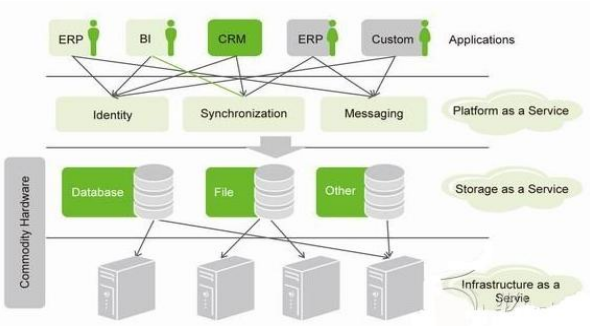


Figure 3. The system architecture of cloud computing platform

Cloud computing is a model for enabling ubiquitous, on-demand network access to a shared pool of configurable computing resources by setting up basic hardware and software infrastructures in a data center [16]. Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. Cloud computing consists of the following levels of service: IaaS (Infrastructure-as-a-Service), PaaS (Platform-as-a-Service), SaaS (Software-as-a-Service) [23, 24].

Distance learning programs that are committed to accessibility assure that course designers understand the program's commitment to accessibility, have access to guidelines and resources. Students learning platform mainly collect student' behavioral information [25]. Teachers platform provides teaching resources, teaching strategies library. Learning scheduling system called from teaching learning content repository, and send to learning platform based on teaching strategies and student characteristics library. Teaching strategies library stores teaching sequences and teaching methods through human-computer interaction, knowledge model, student module obtain information. Data mining module is a data mining engine, which is consists of a group of functional modules and used to describe the association, classification, clustering analysis, and the evolution and deviation analysis [26]. Students with a wide range of mobility impairments may enroll in a distance learning course. Some have no functional hand use at all. They use alternative keyboards, speech input, and other input devices that provide access to all of the Internet-based course materials and navigational tools. Some options use keyboard commands to replace mouse functions and thus cannot fully operate software that requires the use of the mouse. Some students with mobility impairments do not have the fine motor skills required to select small buttons on the screen.

The process of personalized service system as follows: Users need to be authenticated before entering the system. If the user is a learner, the system recommended content to learners based on past learning records [27]. The system will collect learners' learning behavior, including Q & A, test results and other information, and records to student information database. Information mining module deduced student characteristics, and placed signatures. According to student characteristics, teaching strategies, teaching contents extracted from the repository by the teaching learning scheduling system, dynamic recommendations to learners [28]. If the learner is the first time into the system, then the corresponding learning record is empty. System requires learners provided static customized information. System recommended learning content to learners according to the static information, and then dynamically adjusted the learning content based on the test results. If the user is a teacher, the system automatically provides online teaching suggestions to teachers [29].The content recommend to teachers by teachers platform is generated by the system according to the learner information data mining analysis information and cloud computing storage.

Definition 1. Assume that $S=\{s_1,s_2,...,s_n\}$ represents the collection of virtual resources. The whole system can be seen as $m\times n$ matrix:

$$S=\begin{bmatrix} s_{11} & s_{12} & \cdots & s_{1n} \\ s_{21} & s_{21} & \cdots & s_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ s_{m1} & s_{m1} & \cdots & s_{mn} \end{bmatrix} \tag{1}$$

Definition 2. The communication bandwidth of the link between $s_i$ and $s_j$ is definition as follows:

$$\begin{cases} C_k^+=\sum_{i=1}^{m}\{\lambda_k^+\ln\frac{s_k^+}{s_{ik}}+(1-s_k^+)\ln\frac{1-s_k^+}{1-s_{ik}}\} \\ C_k^-=\sum_{j=1}^{m}\{s_k^-\ln\frac{s_k^-}{s_{jk}}+(1-s_k^-)\ln\frac{1-s_k^-}{1-s_{jk}}\} \end{cases} \tag{2}$$

Definition 3. Assume that $m$ represents the number of virtual resources, and then the comprehensive weight of the $s_i$ is definition as follows:

$$WS_i=\sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(\left\|w_i\eta_{ij}-\frac{1}{n}\sum_{k=1}^{n}w_i\eta_{ij}\right\|\right)^2} \tag{3}$$

Virtual experiment is to create a Web visualization in 3D environment, where each object on behalf of the three-dimensional visualization of an experimental object. By clicking and dragging the mouse, the user can perform virtual experiments. Infrastructure network is a combination of virtual laboratory to achieve multimedia computer technology, network technology and simulation technology. Fig. 2 shows the logical structure of distance learning platform. The combination of virtual simulation experimental techniques and cognitive methods gives virtual lab intelligent features. Whether a student or a teacher, you can freely and without hesitation at any time into a virtual laboratory instruments.

## III. HEURISTIC INTELLIGENT DISTANCE LEARNING PLATFORM

Distance learning is acquiring a role that becomes more and more important with the huge diffusion of the Internet and related technologies [30]. Distance learning is when coursework occurs outside the standard classroom [31, 32]. Consequently, the investigation for adequate architectures and platforms supporting flexible distance learning engines and solution is nowadays of great interest in the scientific community. Delivery engine that appears to be a good solution when different and heterogeneous modules have to be integrated in the platform. In this paper, we proposes a novel heuristic intelligent distance learning platform based on information technology and cloud computing.

Fig. 4 shows the cloud computing services platform. It mainly consists of three parts: top tier, middle tier, infrastructure tier. Infrastructure tier consists of three parts: computing, network, storage.

For the conception of this system, we stated with the assumption that the content of distance teaching is not just to put online the content used for classroom teaching. In addition to the classical functions such as editing and formatting a text, the system is enriched with functions to cater for the needs of the instructor designing the course content. The users can thus generate automatically the table of contents, create questions for evaluation purpose and manage the bibliographical references [33, 34]. The graphical construction of the content allows an easy manipulation and a better course structure for a later

adaptation to the learner's profiles. Fig. 5 shows the heuristic intelligent distance learning platform based on cloud computing.

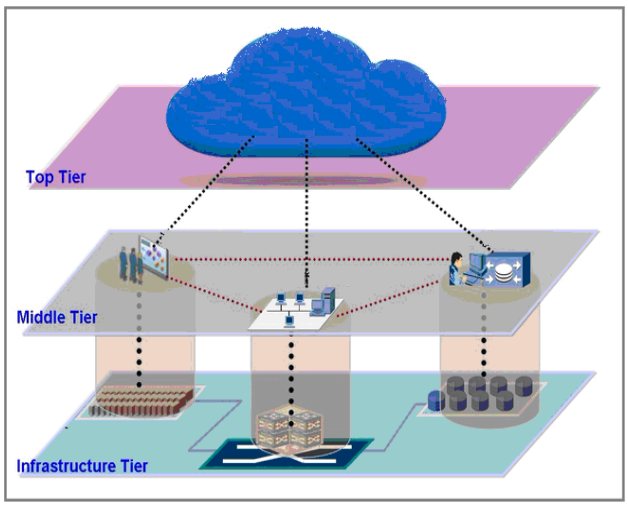


Figure 4. Cloud computing services platform

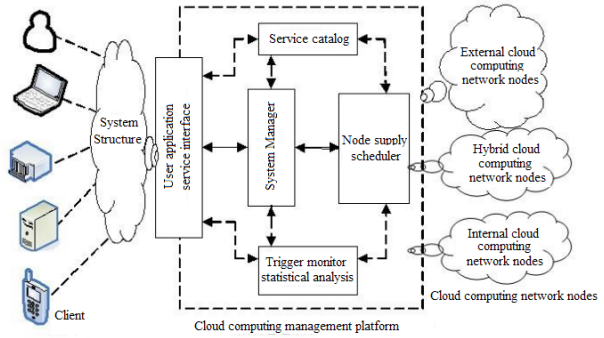


Figure 5. Heuristic intelligent distance learning platform based on cloud computing

The distinctive characteristic of course management systems is to make it possible for individual instructors who have little or no knowledge of HTML or other web oriented programming languages to design and offer online educational contents [35]. The development tools should be integrated in an environment, which will allow the instructors to create Web pages, upload documents and create on line tests and questionnaires and to add components like electronic mail and discussion forums. These systems should also contain management tools that can be used for students' registration and necessary follow-up. Course complements include all what Internet can bring in term of dynamic explanation, interactive and multimedia. The objective is to develop course complements. Tests are designed and used to check the course understanding.

The platform of heuristic intelligent distance learning is an interactive tool used to students for the video training, interactive consulting, teaching and management with the features of resource integration, safe, and reliable. The problems of the platform are solved such as limited bandwidth resources and diverse user needs base on in-depth study of distance learning key technologies. The system was easy to deploy, highly scalable, and low cost operation. It is for students learning modern information technology to provide a strong support. The NHIDL platform has been assembled to give a natural orientation that is specifically prepared for both professional and applied educational needs.

## IV. Experimental Results

The experimentation is an important phase of the prototype implementation, since it enables us to validate the effectiveness of the heuristic intelligent distance learning platform. In this section, the goals of this evaluation are to measure the performance of our proposed algorithm. This paper compares NHIDL algorithm with GA and WLCS algorithm. Genetic algorithm (GA) is a computational model simulates Darwinian natural selection and genetic mechanisms of biological evolution process of biological evolution, is a natural evolutionary process by simulating the optimal solution search methods. Weighted least active connections (WLCS) is the number of active connections currently connected to the service node to get the ranking of the service node, combined with the service node hardware performance data to different service nodes in the system services structure.

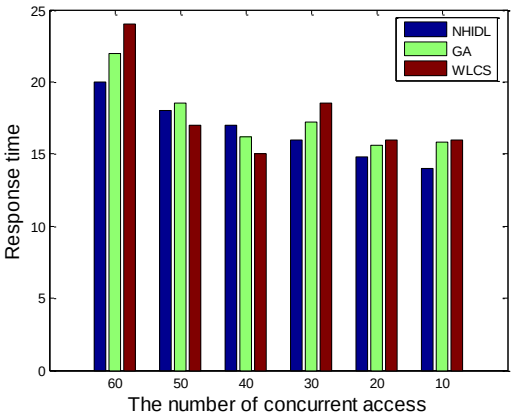


Figure 6. Comparison of the response time for the three algorithms(m=3)

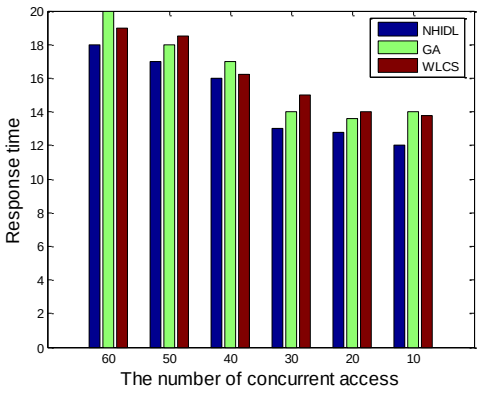


Figure 7. Comparison of the response time for the three algorithms(m=5)

We uses m represents the number of servers. Fig. 6 shows the response time for the three algorithms (m=3).

Fig. 7 shows the response time for the three algorithms (m=5). Fig. 8 shows the execution time for the three algorithms (m=3). Fig. 9 shows the execution time for the three algorithms (m=5). Fig. 10 shows the energy consumption of servers. Fig. 11 shows the number of concurrent access with different servers.

From the results of Fig. 6, we can easily see that the number of concurrent access of NHIDL algorithm significantly better than the other two algorithms. As time increases, the number of concurrent access is also increasing. The performance of GA algorithm is relatively close WLCS. From the results of Figs. 7-8, we can conclude that the response time of NHIDL algorithm significantly better than the other two algorithms. When the number of concurrent access reducing, the response time of the three algorithms are also gradually reduced. From the results of Figs. 9-10, we can conclude that the execution time of NHIDL algorithm significantly better than the GA algorithm and WLCS algorithm. When the number of concurrent access increase, the execution time of the three algorithms are also gradually increasing. In Fig. 11, the energy consumption of servers of NHIDL algorithm is significantly less than the other two algorithms. In Fig. 11, the number of concurrent access of NHIDL algorithm is significantly higher than GA algorithm and WLCS algorithm.

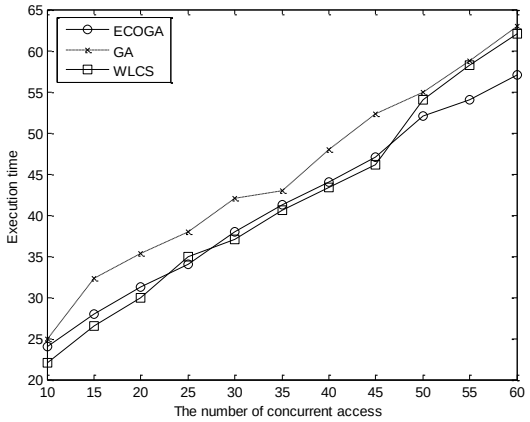


Figure 8. Comparison of the execution time for the three algorithms(m=3)

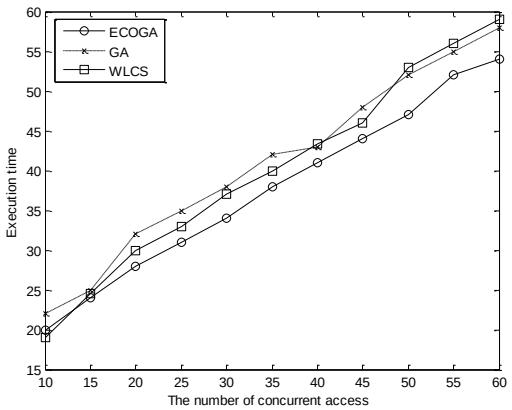


Figure 9. Comparison of the execution time for the three algorithms(m=5)

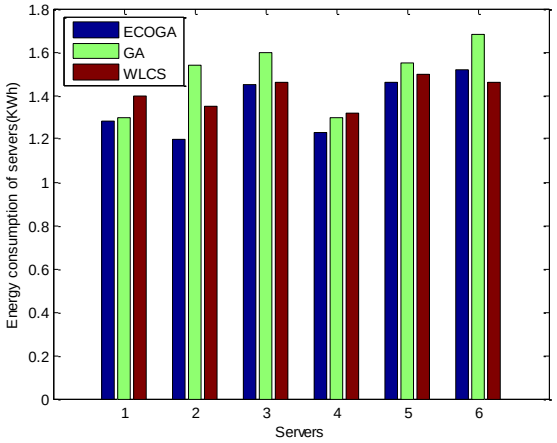


Figure 10. Comparison of the energy consumption of servers for the three algorithms

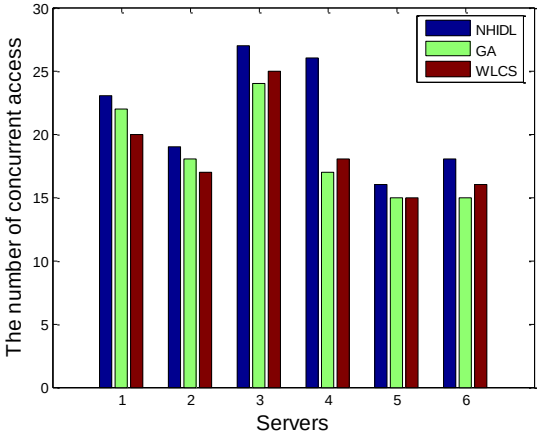


Figure 11. Comparison of the number of concurrent access with different servers for the three algorithms

## V. CONCLUSION

With the development of computer technology, information technology has been fully ruled today in various fields. From the development trend of education, distance education will also become an indispensable part of education system in the future. The heuristic intelligent distance learning platform has shown that technology and education have found a common point to perform good educational methodologies. Construction of universal education system also depends largely on the degree of development of distance education system. This paper proposes a novel heuristic intelligent distance learning platform based on information technology and cloud computing. The proposed platform are committed to accessibility assure that course designers understand the program's commitment to accessibility, have access to guidelines and resources. Experimental results show that the proposed platform can effectively improve the system throughput and reduce the execution time. The NHIDL platform has been assembled to give a natural orientation that is specifically prepared for both professional and applied educational needs.

## ACKNOWLEDGEMENTS

We wish to thank the anonymous reviewers who helped to improve the quality of the paper. The authors gratefully acknowledge the helpful comments and suggestions of the reviewers, which have improved the presentation.

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