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Design and Implementation of Network and Distance Teaching System

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Abstract: *With the rapid advancement of internet, artificial intelligence and big data technologies, intelligent network teaching systems have been widely applied in modern education. Nevertheless, most existing platforms fail to fully utilize massive teaching resources, resulting in low system operating efficiency and poor resource utilization. To address these deficiencies, this paper proposes a personalized network distance teaching system based on big data analysis. The overall architecture and core functional modules of the system are elaborated, and functional and performance tests are conducted through simulation experiments. This system adopts multi-layer architecture and integrates Agent technology and Bayesian network. It mainly realizes two core functions: big data-based personalized resource recommendation and two-way teaching quality evaluation. Experimental results demonstrate that the proposed system can effectively analyze user learning behaviors and push targeted learning resources in real time. Meanwhile, it supports comprehensive evaluation and feedback on students' learning status and teachers' teaching performance. In terms of operational performance, the system occupies less memory and CPU resources and responds faster than traditional intelligent teaching platforms. It can well adapt to diverse practical teaching scenarios and possesses broad application prospects in the field of distance education.*

Keywords: *Distance Teaching; Network Teaching System; Big Data Analysis; Artificial Intelligence; Bayesian Network*

1. Introduction

1.1 Research Background

The popularization of higher education and continuous improvement of education management systems have shifted the focus of education research to the improvement of teaching quality[1]. Traditional offline teaching modes have inherent limitations such as single teaching form and lack of personalized learning options, which restrict the further optimization of teaching effects[2]. Benefiting from the rapid development of information technology, online distance teaching has become an important supplement to traditional classroom teaching. Learners can carry out autonomous learning anytime and anywhere via network teaching systems after class[3].

However, current mainstream network teaching platforms still have prominent drawbacks. Most platforms provide uniform learning contents for all users and rely on learners to select resources independently, lacking targeted guidance and personalized services, which cannot give full play to the advantages of intelligent education[4-5]. In addition, the open and loose operating environment of online teaching also increases the difficulty of objective assessment on students' learning behaviors[6-7]. In recent years, big data analysis technology has been maturely applied in recommendation scenarios such as news and video platforms. It can dig out user behavior rules and actively push interested contents, which provides a new solution for the intelligent upgrading of distance teaching systems[8]. Combining big data and artificial intelligence technologies to build personalized network teaching systems has become an inevitable trend in the development of modern distance education.

1.2 Research Significance

The network distance teaching system designed in this research integrates personalized recommendation and two-way evaluation modules. It makes full use of the advantages of online education to break the constraints of time and space, and greatly improves learners' learning efficiency by realizing differentiated teaching according to individual differences. The combination of artificial

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intelligence and distance teaching can realize automatic acquisition and iterative optimization of system functions, and provide diversified teaching solutions for different teaching scenarios. The research results can not only enrich the technical practice of intelligent distance education, but also provide reference for the construction of similar teaching platforms, which has practical application value for promoting the balanced development of educational resources.

1.3 Current Situation of Network Education at Home and Abroad

Modern network teaching is guided by constructivist learning theories, and interactive teaching and collaborative learning have become typical modes of online education[9]. The core concepts of student-centered teaching have been widely recognized by educators worldwide. In the design of network teaching activities, designers need to fully consider learners' learning interests, motivation and professional training objectives, and allocate classroom time reasonably to balance teaching explanation and practical training[10].

According to Bloom's Taxonomy of Educational Objectives, learning objectives are divided into cognitive, psychomotor and affective domains, and the cognitive domain is further divided into six levels: memory, comprehension, application, analysis, evaluation and creation[11]. The design of teaching activities and evaluation methods should be formulated around measurable learning objectives. Evaluation is divided into formative assessment and summative assessment. Formative assessment focuses on collecting teaching information and optimizing teaching processes, while summative assessment takes scoring as the main purpose. The two assessment methods can be combined in actual teaching[12].

In terms of teaching activity design, the shelf-style mixed teaching strategy is widely used in online and offline hybrid teaching. It splits the lecture content into multiple segments and inserts autonomous learning and interactive activities, which can not only ensure the teaching progress, but also mobilize learners' initiative and avoid mechanical learning[13]. At present, foreign network education platforms pay more attention to the application of intelligent algorithms in personalized recommendation and learning behavior analysis. Domestic research also keeps pace with the times, and a number of intelligent teaching systems based on big data and artificial intelligence have emerged, but there is still room for improvement in resource utilization and personalized service capabilities.

2. Related Technologies of Distance Teaching System

2.1 Agent Technology

Agent technology is an important branch of artificial intelligence. It has the capabilities of autonomous information collection, environmental perception and self-optimization[14]. When applied to distance teaching systems, the Agent module can run automatically in the background, collect learners' learning duration, resource browsing records and interactive behaviors in real time. Combined with preset rules, it analyzes learning states, actively pushes reminder information and learning suggestions, and assists teachers and students to complete daily teaching and learning tasks. The combination of Agent technology and distance teaching can realize the unmanned auxiliary management of the platform and maximize the operational advantages of online education.

2.2 Bayesian Network

Bayesian network is a probabilistic graphical model, which is widely used in uncertain reasoning and data analysis in the field of education[15]. Its mathematical expression is defined as:

$B=(v,E,P)$

$v=\{v1,v2,\ldots,vn\}$

$E=\{vi\ vj \mid vi,vj \in v\}$

$P=\{P(v1 \mid v1,v2,\ldots vi\text{-}1),v1 \in v\}$

In the formula, 'v' represents the node set corresponding to various characteristics of learners; 'E' is the directed edge set, which indicates the causal relationship and dependency between nodes; 'P' stands for the conditional probability set[16]. The Bayesian network has two important independent characteristics: any node is conditionally independent of its non-descendant nodes; all nodes outside

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the Markov blanket of a node are conditionally independent of this node. In this system, Bayesian network is used to model students' learning interests, learning styles and ability levels. By analyzing learning behavior data, it judges individual learning characteristics and provides a data basis for the realization of personalized teaching and resource recommendation.

3. Design of Personalized Network Intelligent Teaching System Based on Big Data Analysis

3.1 Overall System Architecture

This system adopts a four-layer distributed architecture, including client layer, content layer, service layer and data layer. The overall structure is hierarchical with clear logic and good scalability.

Client Layer: The access terminal of the system, including administrator terminal, teacher terminal and student terminal. Users access the system through mainstream browsers to complete identity authentication and corresponding business operations.

Content Layer: Responsible for providing personalized interactive interfaces and classified content display. Users can only enter the navigation page after passing identity authentication, which ensures system access security.

Service Layer: Divided into application service layer and public service layer. The application layer consists of learning modules and communication modules. Learning modules include information interaction, resource sharing, intelligent Q&A and two-way teaching quality evaluation modules. Communication modules cover teaching forums, real-time Q&A and big data personalized recommendation modules, which are the core functional carriers of teaching activities[17]. The public service layer provides basic support for the application layer, including identity authentication, user management, log management, resource management and intelligent guidance modules. It realizes information screening, access control and resource scheduling.

Data Layer: The bottom data storage layer, including learning archives, teaching plans, question banks and teaching resource libraries. It stores all business data generated by the system and provides data support for upper-layer service modules.

All layers cooperate with each other to jointly realize the personalized operation of the system in terms of interface navigation, resource recommendation, interactive communication and intelligent guidance.

3.2 Big Data Personalized Recommendation Module

The big data personalized recommendation module is the core functional module of the system. The module collects user behavior data, extracts behavioral features, constructs feature vectors, and finally completes resource matching and recommendation[18]. The specific implementation steps are as follows:

Collect multi-dimensional data such as user operation logs, browsing behaviors, learning duration and resource evaluation, and convert behavioral information into standardized user feature vectors.

Match user feature vectors with resource attribute data, and initially screen similar learning resources to form a preliminary recommendation list.

Sort the preliminary results according to user feedback and resource popularity, and generate the final recommendation content.

In terms of data processing, a three-layer data processing mechanism is adopted. The first layer is responsible for report statistics, the second layer analyzes user habits, and the third layer manages pending push information. The system supports offline push and real-time push modes, and the real-time push response delay is controlled within 3 seconds, which ensures the timeliness of resource recommendation.

3.3 Two-way Teaching Quality Evaluation Module

The two-way teaching quality evaluation module realizes intelligent attendance, classroom behavior monitoring and mutual evaluation between teachers and students. The module is composed of classroom terminal, student terminal, teacher terminal, educational administration terminal and cloud

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server, and all terminals communicate through mobile networks.

The classroom terminal is equipped with image acquisition equipment. It uses frame processing and target detection algorithms to collect classroom video and image data[19]. The frame processing unit compares adjacent frame images and eliminates invalid repeated data to reduce data transmission volume. The collected data is uploaded to the cloud server for unified storage and analysis. The cloud server is embedded with face detection and classroom behavior recognition models, which can automatically count attendance, calculate listening rate and identify abnormal behaviors.

Teachers, students and educational administrators use their respective terminals to view evaluation results, release notifications and complete mutual evaluations. The processing unit of the cloud server includes attendance analysis, listening behavior analysis and feedback sub-modules. It feeds the analyzed results back to each terminal in real time, realizing closed-loop management of teaching evaluation from data collection, analysis to feedback.

4. Simulation Experiments and Result Analysis

4.1 Experimental Environment

The hardware and software environment for the experiment is set as follows: Host model IPC-610L, Intel i5-9400F CPU, 8GB memory, 250GB hard disk; Operating system Windows 10; Web server IIS 6.1. The experimental subjects are students from Grade 2019 of Hefei University of Economics. The experiments are divided into functional test and performance test.

4.2 System Function Test

4.2.1 Test of Personalized Recommendation Module

The test items include log collection, recommendation effect and multi-user concurrent operation. The experimental results are shown in Table 1. The system can accurately record users' click, viewing and evaluation behaviors, and dynamically update the recommendation list according to real-time operation data. Under multi-user concurrent access, each user can receive matched learning resources normally. The personalized recommendation function operates stably and meets the actual use requirements.

Table 1 Test Results of Big Data Personalized Recommendation Module

Test Items	Experimental Content	Experimental Results
Log Collection	Record user clicks, viewing duration and evaluation behaviors	Accurately record all valid user behaviors
Recommendation Update	Observe the change of recommendation content with user interaction	Dynamically update the recommendation list in real time
Multi-user Test	Verify the service status under concurrent access	All users can receive matched resources normally

4.2.2 Test of Two-way Teaching Quality Evaluation Module

The test covers teacher terminal, student terminal and educational administration terminal. Teachers can upload classroom data, check attendance and listening rate statistics, and release assignments and notifications through the terminal. Students can view personal learning feedback and complete teaching evaluation. Educational administrators can query the overall teaching status of each class.

The system adopts face recognition technology for intelligent attendance statistics. The listening rate curve drawn according to classroom frame data shows that the system can continuously monitor students' learning status within class time[20]. The experimental results prove that the module can complete attendance statistics, behavior analysis and two-way evaluation efficiently, and the evaluation results are objective and reliable.

4.3 System Performance Test

To verify the operational performance of the system, this paper selects two typical intelligent teaching systems proposed by Chen et al.[21] and Fan et al.[22] for comparative tests. Emmagee tool is used to monitor memory usage, CPU occupation, traffic and response time. The comparison results are

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shown in Table 2.

Table 2 Performance Comparison of Three Teaching Systems

System Type	Memory (MB)	CPU Occupation (%)	Additional Traffic (kB)	Response Time (s)
Deep Learning-based Teaching System	14.42	15.27	1025	24
JSP-based Remote Teaching System	13.46	4.66	4	21
Proposed System	8.32	1.32	0	8

It can be seen from Table 2 that the proposed system has obvious advantages in resource occupation and response speed. The maximum memory usage is only 8.32 MB, the CPU occupancy rate is as low as 1.32%, and the average response time of functional modules is 8 seconds. The overall performance is far better than the other two traditional systems, and it is more suitable for long-term and large-scale popularization and application.

5. Conclusion

With the in-depth integration of internet and education, traditional teaching modes are constantly innovated, and network distance teaching has become an indispensable part of modern education. Aiming at the problems of single service and low resource utilization of existing network teaching systems, this paper designs a personalized distance teaching system based on big data and artificial intelligence technologies. The system adopts a four-layer architecture, takes Agent technology and Bayesian network as the technical support, and realizes two core functions: big data personalized resource recommendation and two-way teaching quality evaluation.

Simulation experiments show that the system has complete functions and excellent operating performance. It can dig out users' learning characteristics through behavior data analysis, push targeted learning resources, and realize scientific evaluation of teaching and learning effects. The system has low hardware resource occupation and fast response speed, which can adapt to various network teaching scenarios. In the follow-up research, the algorithm model can be further optimized to improve the accuracy of recommendation and behavior recognition, and expand more intelligent service functions, so as to better serve the development of distance education.

References

[1] Zhang J. Intelligent E-Learning and Digital Library System Based on Big Data Analysis[C]//Proceedings of the 2023 6th International Conference on Information Management and Educational Technology. ACM, 2023: 45-50.

[2] Cen Y F, Jiang S, Cai W X, et al. EGRec: a MOOCs course recommendation model based on knowledge graphs[J]. Discover Applied Sciences, 2025, 7(578): 1-12.

[3] Mubarak A A, Cao H, Zhang W Z. Prediction of Students' Early Dropout Based on Their Interaction Logs[J]. Interactive Learning Environments, 2020, 30(8): 1414-1433.

[4] Mujahid M, Lee E, Rustam F, et al. Sentiment Analysis and Topic Modeling of Online Education Related Content[J]. Applied Sciences, 2021, 11(18): 8438.

[5] Bhardwaj M, Mishra P, Badhani S, et al. Performance Optimization of Online Teaching Platforms[J]. International Journal of System Assurance Engineering and Management, 2022, 13(S2): 210-218.

[6] Truelearn T. A Family of Bayesian Algorithms for Lifelong Learning Resource Matching[EB/OL]. arXiv:1911.09471, 2019.

[7] Li Q, Wang H. Automatic Course Recommendation Method for Online Education Based on Bayesian Model[J]. Journal of Physics: Conference Series, 2024, 2789(1): 012045.

[8] Wang J T. Research on Key Feature Estimation of Big Data in Large-scale Teaching Systems[J]. Modern Electronic Technology, 2018, 41(12): 83-86.

[9] Xiong Y, Sheng Q L. Thoughts and Suggestions on the Integrated Development of Artificial Intelligence and Education[J]. Teaching and Management, 2020(15): 21-24.

[10] Sang H Y, Sun X H. Design of English Teaching Resource Management System Based on Artificial Intelligence[J]. Modern Electronic Technology, 2020, 43(10): 173-175.

ISSN 2616-5775 Vol. 9, Issue 6: 23-28, DOI: 10.25236/AJCIS.2026.090604

[11] Liu J, Zhong X Q, Li X P. Frontier Progress and Challenges of Educational Artificial Intelligence[J]. Research in Higher Engineering Education, 2020(2): 113-123.
[12] Song Y. Design of Practical Teaching System Based on Distributed Virtual Reality[J]. Experimental Technology and Management, 2020, 37(2): 227-232.
[13] Zhang Z Z, Zhang L L, Xu X Y. Metaphor Analysis of Artificial Intelligence in Teaching[J]. China Distance Education, 2019(11): 24-37.
[14] Liu Q T, He H Y, Wu L J. Research on Classroom Teaching Behavior Analysis Based on Artificial Intelligence[J]. China Educational Technology, 2019(9): 13-21.
[15] Liu M, Zhang J P. Research on Design of Future Classroom Intelligent Teaching System[J]. China Educational Technology, 2019(7): 14-21.
[16] Chen K Q, Sha J H, He Y. Functional Upgrade of Intelligent Teaching System under AI 2.0[J]. Distance Education Journal, 2017, 35(5): 40-53.
[17] Chen J Y, Wang Z, Chen J Y. Design of Intelligent Teaching System Based on Deep Learning[J]. Computer Science, 2019, 46(S1): 550-554.
[18] Fan X, Yang M, Xu H R. Design of Remote Teaching Management System Based on JSP[J]. Modern Electronic Technology, 2020, 43(11): 180-182.
[19] Ren Y, Zhang Z N. Application of Artificial Intelligence in Continuing Education[J]. Journal of Chinese Adult Education, 2017(23): 126-128.
[20] Farajollahi B, Mehmannavaz M, Mehrjoo H. Application of Machine Learning in Educational Data Analysis[J]. Frontiers in Health Informatics, 2021, 10(1): 65-70.
[21] Alharbi S, Almutairi M. A Hybrid Recommendation Framework for IoT-based E-learning Systems[J]. IEEE Access, 2026, 14: 3215-3228.
[22] Kim S, Park J. Performance Evaluation of Cloud-based E-learning Platforms[J]. Computers & Electrical Engineering, 2024, 112: 109015.