Application of Blockchain Technology in College Teacher Evaluation System

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ABSTRACT
The teacher evaluation system is a comprehensive information system for teachers and students of the whole school based on the management practice of higher education, using advanced design ideas and technologies. The system effectively overcomes practical problems such as high pressure of evaluation information collection, waste of data, complicated statistical operations, and inaccurate reflection of evaluation results. This paper aims to study the application of blockchain technology in college teacher evaluation system. On the basis of analyzing the key technology of blockchain, the main content of teacher evaluation work and the non-functional requirements of the system, the college teacher evaluation system is designed. Finally, the performance of the system is tested. The test results show that when the number of concurrent users of the system is 300, the maximum response time is 7321ms, the minimum response time is 5721ms, and the average response time is 6324ms, indicating that the system performance basically meets the design requirements.

Keywords: *Blockchain Technology, College Teaching, Teacher Evaluation, Teaching Quality*

1. INTRODUCTION

With the rapid development and application of computer and network technology, network informatization has also begun to penetrate into various fields of China's economic and social development, and educational informatization has also become a common goal of China's higher education development [1-2]. Based on higher education network resources and advanced information technology, and fully utilizing the advantages of the educational network such as high efficiency, convenience, and information sharing, it has realized a unified and all-round networked networked college teacher evaluation system for supervising and managing education. Effective monitoring and management of the effect will play a key role in promoting the design and implementation of the entire Chinese higher education program in the future [3-4].

Blockchain technology has also received unprecedented attention in the education sector. Many higher education organizations and professionals have introduced blockchain technology into higher education information systems to overcome the problem of excessive access to information such as academic performance. Some scholars also use blockchain information technology to extract course-oriented certification data, and save the academic certificate in the blockchain information database, which improves the authenticity of the academic certificate and diploma information, and makes the degree verification work more efficient and effective. It is safe and convenient, and it also saves the time and personnel cost of manually issuing certification and retrieving degree materials [5-6]. There are also blockchain-based authentication platforms for scholars. The platform issues diplomas based on the underlying Bitcoin-based blockchain technology. The bachelor's degree interface can be created in time through the mobile phone application, and the relevant degree information can be viewed and printed. The system is divided into three parts: Cert-schema, Cert-ssuer and Cert-viewer. Cert-schema describes the data specification of digital certificates; Cert-issuer generates the hash value of the digital certificate diploma and sends the certificate to the recipient through a Bitcoin transaction; Cert-viewer is used to view and verify the issued certificate [7-8]. Some researchers use blockchain technology to track students' course progress, academic performance, grades, etc., and use blockchain technology security to leak student records and make them available to teachers and students [9-10]. Through the above related research, it can be found that blockchain technology has begun some attempts and implementations in the field of education.

On the basis of consulting a large number of relevant references, combined with the key technology of blockchain, the main content of teacher evaluation work and the non-functional requirements of the system, this paper designs a university teacher evaluation system based on blockchain technology, and tests the system's performance to check whether it meets the requirements of this article.

2. APPLICATION OF BLOCKCHAIN TECHNOLOGY IN COLLEGE TEACHER EVALUATION SYSTEM

2.1 Key Technologies of Blockchain

(1) Peer-to-peer network

A peer-to-peer network (P2P) is a non-server-based Internet system that exchanges data between different nodes. This is a distributed server structure different from the client/server structure. In the traditional client/server structure, system data is stored on the host server, and users must go through the host server to obtain the required data. The host server has high performance requirements, and the data fault tolerance rate is not high. In a P2P network, each node has the same priority, can provide the same service, does not require a central server for comprehensive data management, and each node can communicate freely and comfortably. P2P networks also have distributed data storage. This feature allows you to replicate and store data to multiple nodes, avoid data loss issues due to single node failure, and improve data storage fault tolerance.

(2) Asymmetric encryption

Both asymmetric and symmetric encryption algorithms are the dominant key computations today. Symmetric encryption also uses the same key to encrypt and decrypt data, but asymmetric encryption requires two keys. The first is the public key. The key is the private key, and the other is the private key. The display of the public key and the private key is a pair, and a public key password can correspond to a private key password. That is, if the public key is used to encrypt data, the corresponding private key can be decoded. If the private key is used for encryption, the corresponding public key encryption needs to be used to decode it. Because the encryption and decryption keys of the asymmetric encryption algorithm are not the same key, the encryption and decryption processes are relatively independent. Also, the private key password cannot be extracted directly from the public key. This greatly increases the stability of data encryption and decryption, and can realize signature and authentication according to this method [11-12].

(3) Hash function

A hash function is also a hash function. This is an input string of random length, but can be converted to a fixed length output string using a hash algorithm. The output string usually refers to the hash of the input string. Due to the data space compression method, a hash value that is much smaller than the original data can generally be generated, but since different strings can generate the same hash value, it is difficult to infer the original string from the hash value. But once the input string is changed, if the characters are changed, the result is completely different, so it can be applied in the verification mode to prevent data leakage during the transmission of the blockchain.

(4) Merkle tree

Merkle tree, as an important part of blockchain, is mainly used to summarize and verify the existence and integrity of blockchain data. It is a binary tree based on sharding. Leaf nodes store data, and corresponding non-leaf nodes store leaves. The node value of the shard is sharded layer by layer, all the way to the root node. Using Merkle trees as data storage structures not only improves blockchain efficiency, but also improves scalability. At the same time, data associations can handle transactional data without traversing complete blocks of data. As long as the data changes during the process of saving the data, the value of the final merkle root node will change, effectively preventing data leakage.

2.2 The Main Content of Teacher Evaluation Work

(1) Evaluation of teaching attitude

Teachers' educational attitude is the basic condition for engaging in this profession. Teachers' morality can be established only when teachers establish a good educational attitude. Teaching attitude also directly reflects teachers' sense of responsibility for their work and should be included in teaching evaluation. Educational attitudes include language attitudes and behavioral attitudes. Linguistic attitude refers to whether teachers can use professional expressions in the classroom to teach the course, and whether the language is used inappropriately during the course.

(2) Evaluation of Teaching Ability

Educational ability mainly includes teachers' professional level and teachers' teaching ability. Professional level reflects the strengths of teachers in a subject. Teachers need both theoretical and practical experience, and teachers can only get better at higher professional levels. Teachers' teaching ability is reflected in teacher preparation before class, classroom teaching and teaching methods. The level of teaching ability directly affects students' acceptance of professional knowledge.

(3) Evaluation of classroom organization ability

The general characteristics of the current situation of students in our country are that they are in a passive learning state, ideologically relieved from the intense learning pressure of the entrance examination, and the subjectivity of learning is not strong. Teachers can significantly improve the classroom effect by strengthening the control of the classroom process,

taking the students' learning attitude seriously, and correcting the students' learning misbehavior in time.

(4) Professional construction evaluation

In addition to educational work, teachers in ordinary universities in our country also need to participate in professional construction work. Under the current situation of high employment pressure for students, teachers need to expand their work ideas and strengthen professional construction. Teachers need to actively carry out school-enterprise cooperation, jointly consider human resource development projects, and actively introduce work categories such as practical projects. These tasks should be used for school administration in the context of teacher assessment.

2.3 System Non-functional Requirements

(1) Reliability

Reliability is measured by the average time interval between failure events, that is, the average probability of failure over a certain period of time. Because generally a server that is continuously working on the system has only one failure per day, and the failure here refers to the user's work problem caused by the defect, because no one likes software that shows errors, errors and system failures more frequently. In order to ensure the security of the system, it is also required to guarantee the time validity of the system, that is, the amount of time that the server can operate and effectively respond to the user. As long as the teachers and students of the evaluation system are turned on, the time utilization rate of the evaluation server will reach 99%, and the downtime will reach one minute to ensure that the online evaluation work of each user is carried out smoothly.

(2) Maintainability

In order to guarantee that the system will be secure in the future, the expected changes in future versions must be described. The system should be easy to expand, update and transplant, and can also reorganize and change service functions, and can flexibly add new service functions on the basis of the original system without affecting the inherent service functions of the original system. New modules can be loaded or adapted quickly, with smooth distribution and updates and flexible scalability. New data can be entered regularly and integrated consistently with the original data, and the efficiency and performance of the system can be improved by improving the configuration of the machine.

(3) Security

First, the Ethereum blockchain platform is a constantly updated platform. Open source features can attract and keep blockchain engineers around the world up-to-date with all the security. The Ethereum side then uses the PoS consent mechanism to ensure the security of the information on the chain.

3. EXPERIMENT

3.1 System Architecture

Create a university teacher evaluation system based on Hyperledger Fabri. The system structure is divided into infrastructure layer, network layer, consensus layer, data layer, smart contract layer, interface layer and application layer. The system architecture is shown in Figure 1.

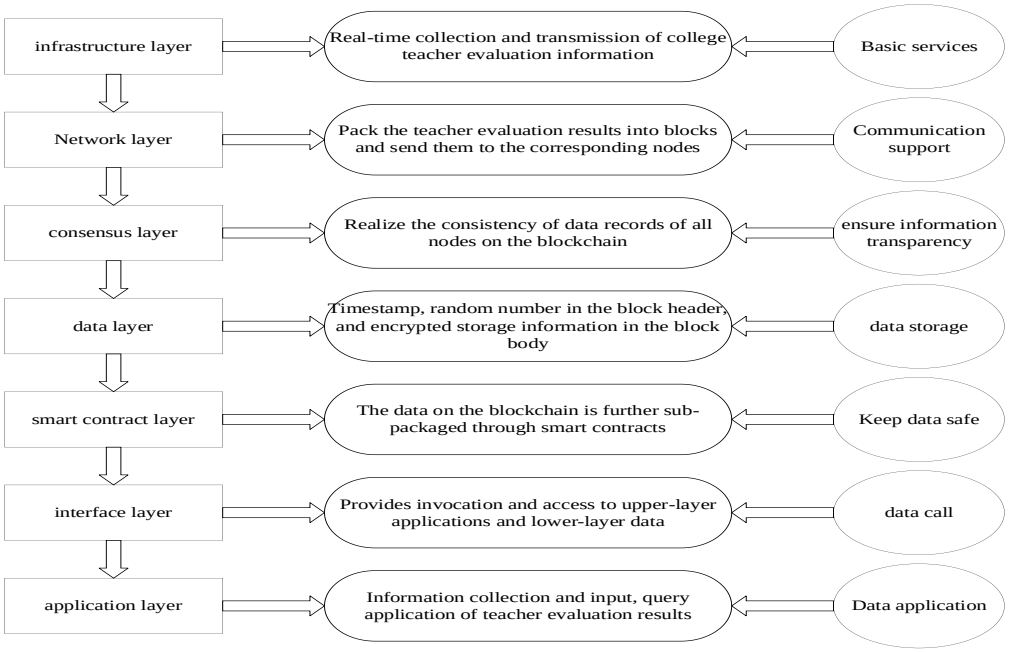

Figure 1. System structure

3.2 Evaluation Main Block

It consists of local education departments, principals, university professors, current students, parents of students, cooperatives, social media companies, and other participants. All subjects are registered, joined to the blockchain and verified and licensed by the system. Educational topics certified and endorsed by entitlement are systematically included in assessment topic blocks. There are two main types of right authentication methods to measure the quality of school education: individual authentication and organizational authentication. Personal identity verification is used by peer teachers, current students and parents of students through local education departments, cooperatives and social media use organizations.

3.3 Evaluation Data Block

Evaluation data is divided into past historical data, current data and future historical data. Among them, the current historical data is acquired by the management system and injected into the previous school-centered teaching database. The current historical data is independently submitted by the school to the management system, while the future historical data is generated by the system, and the information is entered and the teaching activities in the management system are created according to the school's regulations.

3.4 Evaluation Method Block

The module consists of AHP, Fuzzy Hierarchy, Neural Networks, Data Envelope Analysis, SPA Analysis and Factor Analysis. The first two methods are summarized as follows. The process of AHP systematically decomposes the fuzzy and complex educational problems in universities into various elements, and then forms a hierarchical structure according to the dominant relationship of each element, and then verifies the comparison results and the relevant layer-by-layer factors. Determine the weight of each factor. The fuzzy hierarchy method systematically quantifies the fuzzy meaning of university quality indicators, determines the fuzzy weights of the indicators through AHP, establishes a crisis matrix for fuzzy evaluation, calculates standard values, and evaluates each evaluation indicator.

3.5 Algorithm Implementation

The digital content and session log data in this paper are encrypted and decrypted using a temporary shared key, which greatly improves the security of the data. The copyright owner and purchaser exchange random data in plain text and generate a temporary shared key known only to both parties through the ELGamal encryption algorithm.

Let g be the generator of the cyclic group and p be a large prime number. The steps to generate a temporary shared key are as follows:

Step 1: User A generates a random natural number a, and 0<a<p -1, calculate:

$$X = g^a \bmod p \qquad (1)$$

User A then sends X to User B;

Step 2: User B generates a random natural number b, and 0<b<p -1, calculate:

$$Y = g^b \bmod p \qquad (2)$$

4. DISCUSSION

According to the system performance requirement indicators, this paper uses the pressure measurement tool LoadRunner to test the system performance. The performance test method is introduced below, and the test results are displayed and analyzed. The performance test method is as follows:

User concurrency: Use virtual users to simulate high concurrency scenarios of varying degrees and record changes in network response time.

Table 1. User Concurrency Performance Test

	Maximum network response time/ms	Minimum network response time/ms	Average network response time/ms
50	1646	1255	1513
100	2654	1311	2421
150	3310	1836	2876
200	4572	2422	4173
250	5673	3379	4578
300	7321	5721	6324

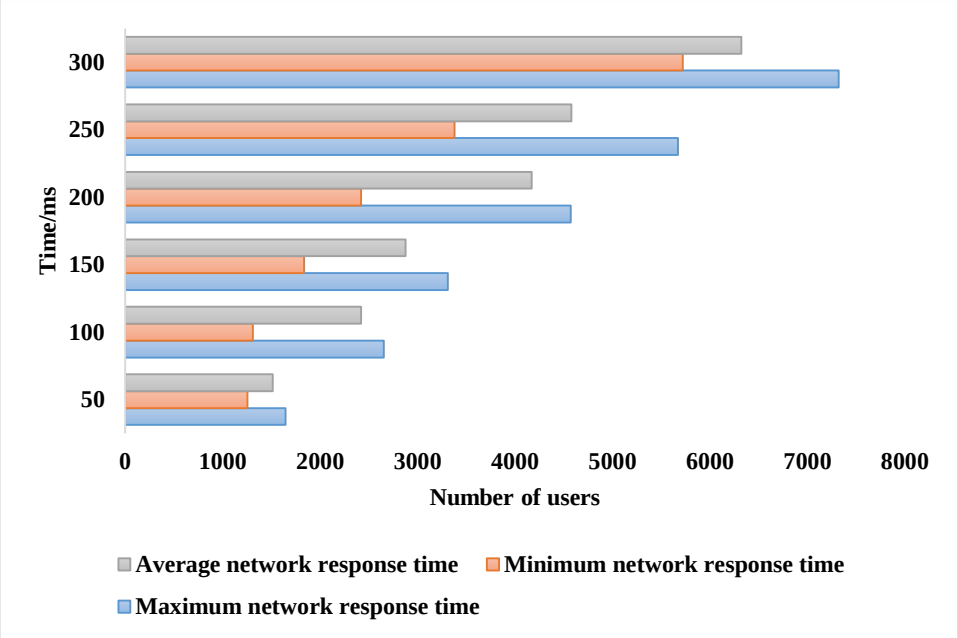

Figure 2. User Concurrency Performance Test

As can be seen from Table 1 and Figure 2, when the number of concurrent users of the system is 300, the maximum response time is 7321ms, the minimum response time is 5721ms, and the average response time is 6324ms, indicating that the system performance basically meets the design requirements.

5. CONCLUSIONS

At present, the evaluation of college teachers is facing a series of problems. The blockchain has the technical characteristics of decentralization, advanced confidentiality, anti-counterfeiting traceability, and smart contracts. It is precisely because of the technical characteristics of the blockchain that it can be widely used in the evaluation of college teachers. Therefore, local education departments and colleges must more actively apply blockchain technology to the management of college teacher evaluations to further improve the quality of college teacher evaluations.

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REFERENCES

[1] Mser M, Soska K, Heilman E, et al. An Empirical Analysis of Traceability in the Monero Blockchain. Proceedings on Privacy Enhancing Technologies, 2018, 2018(3):143-163.

[2] Esposito C, Santis A D, Tortora G, et al. Blockchain: A Panacea for Healthcare Cloud-Based Data Security and Privacy?. IEEE Cloud Computing, 2018, 5(1):31-37.

[3] Zhi L, Wang W M, Guo L, et al. Toward open manufacturing: A cross-enterprises knowledge and services exchange framework based on blockchain and edge computing. Industrial Management & Data Systems, 2018, 118(9):303-320.

[4] Reyna A, C Martín, Chen J, et al. On blockchain and its integration with IoT. Challenges and opportunities. Future Generation Computer Systems, 2018, 88(NOV.):173-190.

[5] Jang H, Lee J. An Empirical Study on Modeling and Prediction of Bitcoin Prices with Bayesian Neural Networks Based on Blockchain Information. IEEE Access, 2018, PP(99):1-1.

[6] Miraz M H, Ali M. Applications of Blockchain Technology beyond Cryptocurrency. Annals of Emerging Technologies in Computing, 2018, 2(1):1-6.

[7] Hammi M T, Hammi B, Bellot P, et al. Bubbles of Trust: a decentralized Blockchain-based authentication system for IoT. Computers & Security, 2018, 78(sep.):126-142.

[8] Puthal D, Malik N, Mohanty S P, et al. The Blockchain as a Decentralized Security Framework [Future Directions]. IEEE Consumer Electronics Magazine, 2018, 7(2):18-21.

[9] Feng G, Zhu L , Meng S , et al. A Blockchain-Based Privacy-Preserving Payment Mechanism for Vehicle-to-Grid Networks. IEEE Network, 2018, 32(6):184-192.

[10] Sharma V, You I, Palmieri F, et al. Secure and Energy-Efficient Handover in Fog Networks Using Blockchain-Based DMM. IEEE Communications Magazine, 2018, 56(5):22-31.

[11] Deepak P, Nisha M, Mohanty S P, et al. Everything You Wanted to Know About the Blockchain: Its Promise, Components, Processes, and Problems. IEEE Consumer Electronics Magazine, 2018, 7(4):6-14.

[12] Lun L, Liu J, Cheng L, et al. CreditCoin: A Privacy-Preserving Blockchain-Based Incentive Announcement Network for Communications of Smart Vehicles. IEEE Transactions on Intelligent Transportation Systems, 2018, 19(99):2204-2220.