






Design of University Integrated Education Management System Based on Blockchain Technology

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Abstract. In order to promote the rapid integration and development of diversified special education management informationization in colleges and universities, a service platform for special education in colleges and universities is built by combining the application of blockchain technology, which realizes the integrity and ownership of information verification, protects the privacy of special students to the greatest extent, and can effectively link multiple management departments to share and interoperate, and provide personalized services according to actual needs. To some extent, the problem of data security interaction in the process of comprehensive education management is solved. At the same time, the research conclusions and suggestions will provide the theoretical and practical basis for effectively promoting the informatization of special education in the later period.

Keywords: Blockchain · Integrated Education · Management Platform · Data Security · Education Informatization

1 Introduction

UNESCO put forward in the Salamanca Declaration and Programme of Action on Special Needs Education adopted at the World Conference on Special Education held in Salamanca, Spain in 1994 that inclusive education refers to arranging disabled students in regular schools as far as possible on the basis of equality and non-discrimination, and providing support and assistance that best suits their needs [1]. Help disabled students with different learning styles, abilities and backgrounds to receive the best public education possible [1]. With the development of integrated education in recent years, many universities in China have joined the pilot of integrated education one after another, and according to the official statistics of the National Disabled Persons' Federation, a total of 47,885 persons with disabilities have enrolled in general higher education institutions nationwide from FY17 to FY20 (2017: 10,818; 2018: 11,154; 2019: 12,362; 2020: 13,551), and promote the construction process of integrated education management.

For colleges and universities, facing the particularity of students, how to know the actual situation of students in real time, and follow the ethical premise of respect, protection and care, mobilize the resources of other departments of colleges and university, and provide services and help as needed is the work that the comprehensive education management department of colleges and universities needs to pay close attention to [2]. Disabled students are a special existence in colleges and universities, and their personal information is related to their privacy. Traditional information technology has obvious defects in solving data security, so this special group will pay special attention to the security and reliability of system data when declaring personal privacy. On the other hand, students with disabilities are physically disabled, and their mobility is inconvenient. Enterprise management belongs to different administrative departments, so it is inevitable that they need to go to different departments, which leads to mobility problems. Blockchain technology directly supports transactions between interactive entities, and provides decentralization through cryptography and game theory, which provides theoretical support for the construction of an integrated education management system [3].

2 Current Research

Using literature research, field interviews, and survey research, we found that the current research on integrating blockchain technology and educational platform construction is in the preliminary exploration stage and has not yet involved the construction of an integrated educational platform. We also searched for “big data + special education + system” as a keyword and found that big data analysis methods are relatively rare in special education informatization research, compared to educational platform design [4]. There are several shortcomings in the existing research: first, the integration of blockchain technology into the construction of education management platform stops at the theoretical exploration stage, and the practical foundation is weak; second, there is a lack of research design and development of special education platform in the existing education management system, and special education informatization needs to be further strengthened; third, the research data of education platform comes from third-party management agencies, and the real-time access to data and time cost are not Fourth, it is difficult to conduct further in-depth analysis for typical cases in the platform.

3 Blockchain-Related Technologies

3.1 Blockchain Concept

The blockchain concept, first proposed by Satoshi Nakamoto in 2008, is a distributed ledger technology that is secured by cryptography for transmission and consistent data storage, and is characterized by decentralization, collective maintainability, traceability, immutability, and anonymity letters [5]. Blockchain is currently highly valued and widely used by countries around the world, and its unique technical advantages have promoted the reconfiguration of governance mechanisms in the digital era.

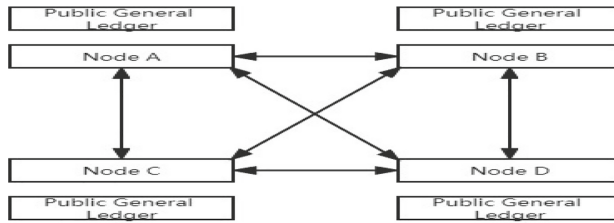


Fig. 1. Decentralized public ledger

3.2 Blockchain Technology

Blockchain technology is a new distributed infrastructure and computing paradigm that uses blockchain data structures to verify and store data, distribute node consensus algorithms to generate and update data, cryptography to secure data transmission and access, and smart contracts composed of automated scripting code to program and manipulate data [6]. In simple terms, in the blockchain system, every time, the transaction data generated by each participating subject will be packaged into a data block, and the data blocks are arranged in chronological order to form a chain of data blocks, and each participating subject has the same data chain, which cannot be tampered with unilaterally, and any modification of information can only be done with the consent of an agreed percentage of subjects, and only new information can be added, and old information cannot be deleted or modified. It is impossible to delete or modify old information, thus realizing information sharing and consistent decision making among multiple subjects and ensuring the unavailability, openness and transparency of the identity and transaction information among the subjects. All nodes keep the same public ledger and maintained in the consistency of the general ledger through distributed consensus, as shown in Fig. 1.

3.3 Technical Commonality

The four main components of blockchain projects, which are common to the technology: blocks, accounts, smart contracts, and consensus, constitute a common model for current blockchain systems [7]. The history of state changes is recorded through a chain structure, with a “snapshot” of the state of each change recorded in the form of a “block”: the identity of the participants is represented through asymmetric key pairs, and the current information is recorded in some form of state database, which is called This part is called “account”; the commitment between participants is defined by on-chain coding, which is called “smart contract”; and the state is agreed between multiple nodes by some algorithm, which is called “consensus”. This process is called “consensus”. The principle of operation is shown in Fig. 2, where the parties negotiate, agree and then deploy to the blockchain in the form of a smart contract.

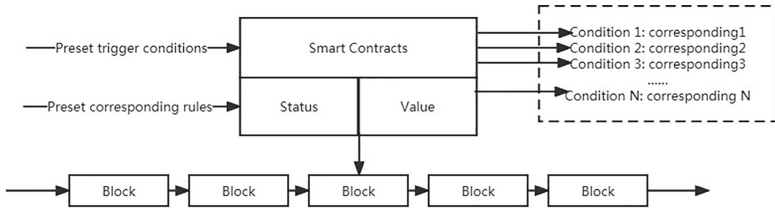


Fig. 2. Smart contract operation principle

3.4 Technical Features

Blockchain is essentially a robust and secure distributed state machine with typical technical components including consensus algorithms, P2P communication, cryptography, database technology, and virtual machines [8]. These also constitute the five core capabilities essential to blockchain.

Stored data: derived from the development of database technology and hardware storage computing power, the size of the blockchain continues to rise as it accumulates over time, and the mature hardware storage computing power makes it possible to store large amounts of the same data simultaneously among multiple subjects.

Shared data: derived from consensus algorithm, each subject participating in the blockchain automatically reaches consensus through the agreed decision-making mechanism and shares the same trusted data ledger.

Distributed: derived from P2P communication technology, realizing peer-to-peer information transmission among subjects.

Anti-tampering and privacy protection: derived from the use of cryptography, through public and private keys, hashing algorithms and other cryptographic tools to ensure the security of the identity of each subject and shared information.

Digital contract: derived from virtual machine technology, the generated cross-subject digital smart contract is written into the blockchain system, and the execution of the digital contract is driven by the preset trigger conditions.

4 Construction of Integrated Education Management System

4.1 Preliminary Concept

Based on blockchain technology, the exchange and redistribution of data among multiple parties such as participants, administrators, and collaborators of integrated education is directly controlled in the form of code design, forming digital smart contracts that are written into the system and driven for execution thus enabling the development and application of integrated education management software to interact in a blockchain manner and provide services to participating users [9]. Ensuring a high level of security and creating an effective technical base to support and enhance the support, coordination and security of the service co-build.

4.2 System Design

First, a database of special students in the region is established to ensure the comprehensiveness, accuracy, and immediacy of data sources as much as possible [3], to provide guarantees for the acquisition, processing, and analysis of relevant data, and to support scientific assessment and decision making; basic information on special students is provided through three major panels of enrollment data from the civil affairs, disability, and admissions offices. The Personal Health Record (PHR) of the special student group is involved here, which is the core of the original data of the system, and the goal is the complete record collected, including the provider cause of disability, consultation data, rehabilitation records, disability level review, etc. The adoption of blockchain technology allows for the distribution of control to individuals and related departments through decentralization achieved by consensus algorithms. Since blockchain eliminates the leakage of privacy that may be caused in data transmission through traditional means of information transmission, it safeguards the information security rights of students.

Secondly, through the medical examination of enrollment, special students are evaluated, diagnosed, and given exercise prescriptions for rehabilitation training through the health screening of the school hospital, and an initial special education resource base is established to provide support for resource sharing. After the information is shared, the relevant information can be collected in a timely manner by all relevant units involving the college and the school, and also provides support for later detection and feedback.

Figure 3 shows the system security interaction architecture, in which the blockchain is connected to different operation status database systems.

Each database system shown in Fig. 3 opens a new secure data channel, similar to the one used to share data with other similar systems. Then, based on mutual agreements, smart contracts are used to manage data transactions between these systems and create an unchanging history of all transactions recorded.

Third, based on the assessment and the needs of the special student, we provide support and assistance in multiple ways, while creating a health file pocket for the special student, recording basic information, program participation, stage problems and treatments, as well as records of participation in various types of support and rehabilitation programs, and evaluation of their effectiveness, to build a complete Integrated education management system (The IDSH model [10] was developed).

System design performance and requirements

Compatibility: low hardware requirements and low dependence on software.

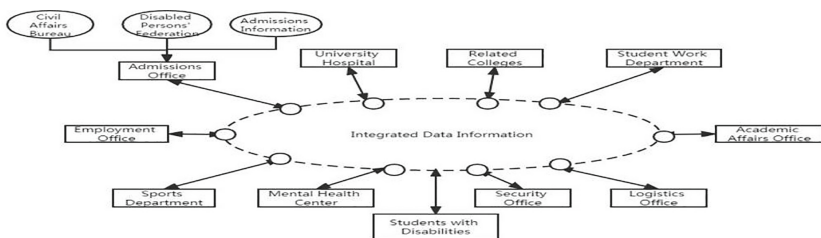


Fig. 3. System security interaction architecture diagram

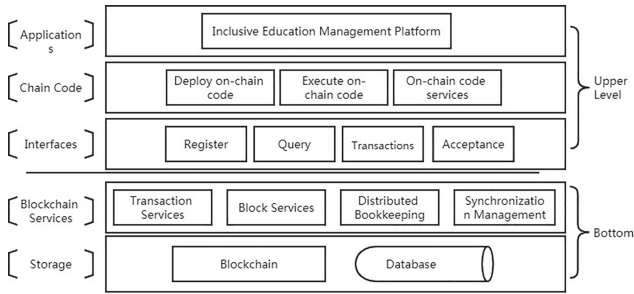


Fig. 4. System architecture diagram

Security: ensure transmission security, system security, and mechanism security.

4.3 Overall System Architecture

System Architecture

The overall architectural atmosphere has two parts: the upper layer and the bottom layer, as detailed in Fig. 4.

The upper part includes the interface layer that provides external and internal interfaces, the on-chain code layer that provides relevant services according to the characteristic requirements, and the application layer that provides services to students with disabilities. The internal interface is used for internal communication between nodes; the external interface is used for external users. The on-chain code layer has the functions of transaction sending, status monitoring, and status storage.

The bottom part includes the storage layer and the blockchain service layer, on which the network-wide transactions and data records are performed.

System Development Technologies

The system involves several subsystems such as mobile terminal and backend server, developed with Android, Objective-C, PHP, etc. The backend server hardware is rented from a third party hosted server [3]. The system can run on Android, iOS, Windows, Linux and other current mainstream mobile terminals and PC operating systems.

In terms of security consideration, the account password security is mainly secured by using MD5 + RSA (asymmetric encryption algorithm). Data security and uniqueness are ensured by three major authentication, login authentication and identity authentication in all aspects.

4.4 System Function Module

Collection of information: Docking with functional platforms such as school new student registration system, student management system and medical examination system, basic data information related to students can be collected.

Health screening: Based on the identification of students' health information in the states of entering, staying and leaving school, the identification and reading of non-health information is realized at the first time.

Teaching support: Realize information interchange with course selection and academic affairs platform to realize temporary adjustment, suspension, resumption, examination and retake of students' relevant courses.

Financial aid support: Docking with the student financial aid system, it can automatically identify the specific situation of non-healthy students, whether they are included in the category of temporary or long-term financial aid, and make timely adjustments to the level of financial aid according to the students' recovery.

Psychological assistance: Interfaced with the student mental health system, it can track and collect the psychological changes of the students concerned in real time, and give timely psychological guidance or intervention to ensure that the mental health indications of this student group are maintained in a normal state.

Sports participation: In the form of online courseware, ppt, video and catechism, students are guided in real time to participate in sports that are suitable for their physical conditions or health level, and assisted in physical rehabilitation activities.

Employment guidance and recommendation: Combining comprehensive factors such as students' academics, physical rehabilitation, career intentions, and corporate positions, we assist in recommending suitable employment positions to help students in this category find smooth employment.

5 Conclusions

The core of the construction of integrated education management system is the privacy of information interaction as well as the sharing of information and the convenience of services. Based on blockchain technology, this paper constructs a model of integrated education management system to prove the great potential and extensive possibilities of blockchain technology in creating an integrated education management system with information security, information sharing, convenient services and clear records, and extrapolates it to other aspects of public teaching management platform construction.

Acknowledgements. This study is the result of a general project of Sichuan Special Education Development Research Center 2022, "Constructing a Competency Model for Disability and Health Integration Managers in Universities" (Grant No. SCTJ-2022-B-09).

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