Design and Implementation of Targeted Poverty Alleviation System Based on Blockchain Network

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Abstract. Targeted poverty alleviation is an important strategy to win the battle against poverty. In order to solve the problems of capital misappropriation and false poverty alleviation in the process of targeted poverty alleviation, a targeted poverty alleviation system based on blockchain network was designed and implemented. The system creatively draws on the characteristics and advantages of consensus mechanism, irreducible modification, traceability, distributed ledger and decentralization in blockchain network to the practice of precision poverty alleviation, and realizes "blockchain + targeted poverty alleviation" rural service integration platform. The system is applied to the digital supervision of poverty alleviation funds from village-to-household in the promotion of targeted poverty alleviation work by poverty alleviation units at all levels, and truly realizes that the poverty alleviation data in each link is true, reliable, provable, traceable and auditable. At the same time, it provides solid underlying credible data support for the "last mile" problem faced by village-to-household in targeted poverty alleviation work.

Keywords: Blockchain network · Precision poverty alleviation · Non-tampering · Traceability

1 Introduction

The report of the 19th National Congress of the Communist Party of China pointed out that "from now to 2020, it is a decisive period for building a moderately prosperous society in an all-round way", and it emphasized the need to "resolutely win the tough battle against poverty [1]". At present, all localities and departments are implementing the basic strategy of targeted poverty alleviation [2]; in order to win the poverty alleviation war, they are committed to innovating work models and overcoming difficulties. While my country has made great achievements in poverty alleviation, there are also many problems. At present, the main problems faced by targeted poverty alleviation work are as follows: insufficient information sharing between relevant governments and poverty alleviation objects, resulting in false poverty alleviation [3] or poor poverty alleviation work; the opaque use of poverty alleviation funds makes the process of poverty alleviation inconvenient to supervise [4, 5], and the problem of power being commodified easily

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occurs; the lack of a system to integrate information from all parties leads to slow updating of data and information, and information exchange is limited; the identification of the poor is "only out but not in", and there is a lack of support for people who have been lifted out of poverty. Dynamic tracking and precise management [6].

With the continuous development of Internet technology, the advantages of blockchain technology [7] have brought new ideas for targeted poverty alleviation and provided technical support. The traceability mechanism and time stamp mechanism [8] in the blockchain ensure the authenticity of the data in the targeted poverty alleviation work, and also solve the "opaque" and "inaccurate" problems in the targeted poverty alleviation work; the smart contract mechanism [9] is conducive to the combination of approval, service and supervision [10]. Therefore, it is necessary to apply blockchain technology to targeted poverty alleviation to ensure that poverty alleviation data cannot be tampered with and the source of poverty alleviation funds can be traced back.

This paper proposes to design and implement a provable, traceable and auditable targeted poverty alleviation system using blockchain technology. The contributions of our research are as follows:

1. This research establishes an authentic and credible basic data management system, and deploys a blockchain platform architecture with the advantages of data transparency, distributed storage, and trustworthiness for targeted poverty alleviation projects. Our research promotes the establishment of a tamper-proof and traceable information integration mechanism in targeted poverty alleviation projects.
2. A safe and efficient data exchange and sharing platform have been built to ensure the efficiency and safety of the information flow of targeted poverty alleviation projects, and to achieve traceable data usage. The platform provides a channel for data sharing of targeted poverty alleviation projects, thereby expanding service models and strengthening multi-departmental collaboration capabilities.
3. Created a regulatory audit service center for intelligent analysis. The center is committed to comprehensively controlling the progress of the implementation of targeted poverty alleviation projects and the use of funds, supporting dynamic performance assessment; improving data analysis capabilities and processing efficiency, and providing accurate, effective, and reliable data support for poverty alleviation decision-making.

2 System Design and Implementation

2.1 System Architecture Design

The targeted poverty alleviation system proposed in this paper involves three layers, namely the user layer, the application layer and the blockchain layer. Its overall design is shown in Fig. 1.

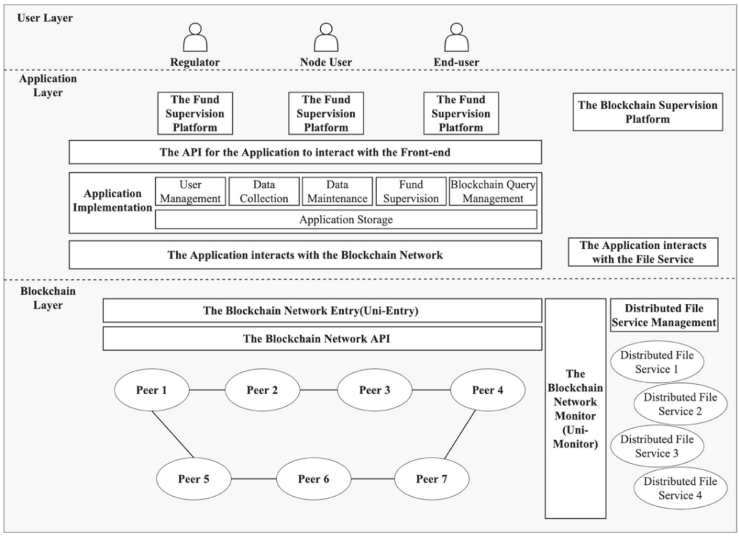

Fig. 1. System structure

2.2 User Layer

The user layer mainly involves three types of user roles: system management roles, system node roles and common user roles. The different user roles are defined as follows:

1. The system management user is responsible for the distribution of node user rights and the operation, management and maintenance of the blockchain system.
2. The blockchain node user is responsible for data entry and maintenance during the tracking process.
3. The end-user of the blockchain system can query the whole process information of traceability and anti-counterfeiting through the web platform.

2.3 Application Layer

Poverty Alleviation Fund Supervision Traceability Platform. The fund supervision traceability platform provides corresponding functions for different user roles, including user management module, data collection and maintenance module, blockchain query module, etc.

The user management module includes functions such as user account assignment and maintenance, and user authority assignment and maintenance.

The module of data collection and maintenance includes data collection function and maintenance function. The collected data is temporarily stored in the database of the application layer, and then stored in the block of the blockchain after the node confirms it.

The blockchain management query module includes functions such as blockchain management, blockchain data statistics, blockchain data query, etc. All query requests of this module are for data on the blockchain.

Poverty Alleviation Fund Supervision Traceability Query Platform. The poverty alleviation fund traceability query platform can provide various users with the ability to query the traceability data of poverty alleviation funds.

This platform mainly obtains the tracking information of poverty alleviation funds in each link by calling the query API interface provided by the blockchain. The platform is user-friendly. The traceability tracking data is displayed in the way of traceability, including the tracking data of each link, the collected documents and picture data, etc.

Blockchain Monitoring Platform. The blockchain monitoring platform provides blockchain network monitoring capabilities for blockchain system management roles.

The platform monitors the operation indicators of each node of the blockchain in real time. When the indicator of a node in the blockchain network exceeds the threshold, it will judge the node as abnormal and send an alarm to the relevant personnel by email, so that they can maintain the stable operation of the system in time.

2.4 Blockchain Layer

Blockchain Node. The blockchain network deploys 7 nodes, respectively deploying blockchain nodes on business stakeholders to form a blockchain node cluster. Among them, 4 nodes are deployed by the regulatory department, and 3 nodes are deployed by other institutions.

Blockchain Storage. The information involved in traceability tracking has various data forms, including metadata description form, image form, document form, etc.

The system will further sort out the collected data fields, classify the data fields according to different business links, and design them into a standard metadata description structure. The metadata description information is entered into the chain in JSON structure and stored in the block of the blockchain. The relevant pictures and documents collected during the process will be stored on a dedicated file server, and the files themselves will not enter the chain. Instead, the hash calculation will be performed on the picture and document file directories, and the unique identification of the files obtained after the calculation will be uploaded to the block.

Blockchain Entry. The blockchain provides creation and query interfaces to external business requests through APIs. The application layer cannot directly access the blockchain node machine, but access the blockchain through the unified entry of the blockchain. At the same time, the blockchain entry provides functions such as request load balancing, illegal request filtering, and high service availability.

Blockchain API Interface. The blockchain network will provide two types of APIs, data creation and data query.

The data creation API realizes the in-chain operation of collecting metadata in each link; the data query API realizes the query operation of the data on the chain, such as the query of the collected data of each link, and the query of the whole-process traceability data.

Blockchain Monitoring. A monitoring data collection module is deployed at each node of the blockchain to collect business indicator data of each link such as hardware resource occupancy and consensus on building blocks of the blockchain, providing monitoring data sources for the blockchain monitoring platform.

Blockchain Deployment. The deployment of the blockchain is shown in Fig. 2.

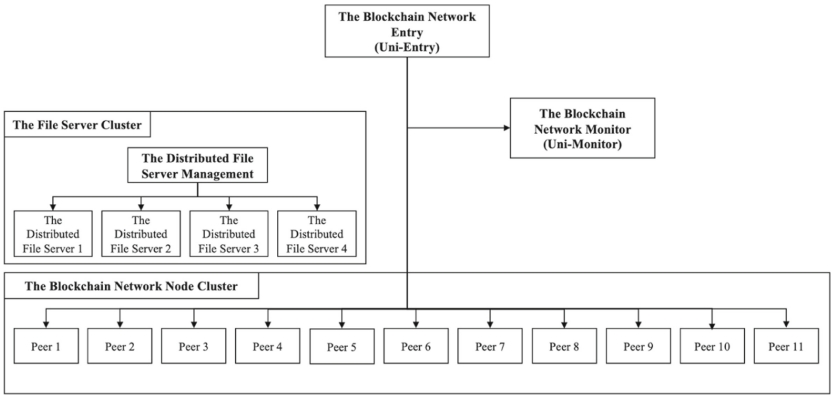

Fig. 2. The deployment of the blockchain

The occupancy of deployment machines is shown in Table 1 and Table 2.

Table 1. Block chain deployment machine occupancy.

Application deployment	Occupation of machines and uses
Uni-Entry	2 servers (nginx master/standby service)
Uni-Monitor	1 server (Grafana + InfluxDB, etc.)
Uni-Chain	7 servers (Unichain + RDb + LDb + collected, etc.) (4 nodes for regulatory authorities, 3 nodes for other related parties)

Table 2. File service deployment machine occupancy.

Application deployment	Occupation of machines and uses
Distributed file service management node	1 server
Distributed file service storage node	4 servers

3 The Practice of Blockchain in the Process of Targeted Poverty Alleviation

This system is mainly used in the informatization supervision of village-to-house poverty alleviation funds in the promotion of targeted poverty alleviation by poverty alleviation units at all levels. For various types of funds such as central financial funds, provincial financial funds, county financial funds, and industry poverty alleviation funds, it can achieve non-tamperable ledger operations and list management, and conduct inquiries and statistical analysis of all poverty alleviation funds.

The regulatory authorities can enter the information involved in the poverty alleviation fund policy, account arrival, allocation, integration, and other links into the blockchain system through the blockchain node. This information includes land and document number, direction of funding support, year of fund allocation, fund type, project to which the fund belongs, fund disbursement unit, fund receiving unit, fund amount, fund disbursement batches, etc. System users, such as fund sources, regulatory authorities, and poverty alleviation targets, can query and view traceable fund flow information on the platform at any time, as shown in Fig. 3.

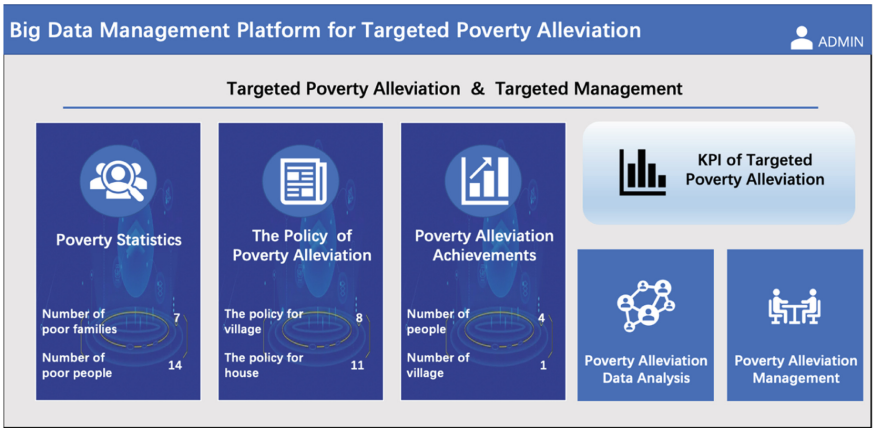

Fig. 3. The precision poverty alleviation big data platform

At present, the targeted poverty alleviation big data platform has covered 12 regions including Gansu, Yunnan, Shaanxi, Jiangxi, Henan, Hainan, Xinjiang, and Qinghai, serving more than 40% of the poor in China.

4 Conclusion

The application of blockchain technology to targeted poverty alleviation work provides a unified window for solving poverty alleviation and livelihood problems for the poor at the grassroots level. Blockchain technology enables tamper-proof poverty alleviation data and traceability of poverty alleviation funds, ensuring that the grassroots can effectively

enjoy preferential policies. It provides a convenient channel for the people to feedback problems, social supervision and evaluation, and the government to solve problems. This research provides a feasible solution for really promoting the broad participation and deep participation of the masses in poverty alleviation work. At the same time, it realizes targeted and meticulous work mode and two-way feedback for the whole process of poverty alleviation, such as targeted poverty situation identification, targeted policy implementation, and targeted poverty status cancellation. The proposed model ensures that the effectiveness of poverty alleviation is recognized by the people.

The application of blockchain technology in the field of targeted poverty alleviation has great advantages. Relying on the blockchain can solve the problems of information asymmetry and illegal scale, and achieve low-cost and high-efficiency coverage of poverty alleviation funds.

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