Research on Information Sharing Application of Collaborative Government Affairs System Based on Blockchain
Take Social Security Government Affairs as an Example

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Abstract. In the process of collaborative government affairs under the existing e-government environment, there are problems such as data isolation of different departments, complex inter-departmental business processing, insufficient data sharing, and difficulty for citizens to handle government affairs. In response to this problem, this paper takes blockchain theory and collaboration theory as theoretical guidance, uses digital identity and data sharing platform as application, adopts authorization-based consensus mechanism combined with Byzantine fault-tolerant mechanism, and takes social security-related government affairs as an example. Collaborative government data sharing application based on blockchain technology. This application can promote heterogeneous data sharing, unimpeded cross-departmental business collaboration, and remote government affairs for citizens, which is conducive to promoting the formation of a simple, efficient and low-consumption government system.

Keywords: Blockchain technology · E-government system · Digital identity · Social security

1 Introduction

The application of blockchain technology is derived from Bitcoin. After more than ten years of development, it has extended to all fields of the entire society. Due to its novelty of technical characteristics and rapid development momentum, it has received widespread attention from the entire society. At present, the application of blockchain in the financial industry represented by virtual currency is relatively mature, and the integration with other industries is still in its infancy. "Blockchain + e-government" is the integration process of blockchain and public management. After one attempt, countries all over the world have launched active explorations.

The problems that the government needs to deal with in modern society are becoming more and more complex. It is faced with problems such as large amount of government information, rapid growth, and information barriers to heterogeneous information. A problem in the field of public services often requires collaborative management services and related information from multiple government functional departments. Only in this field can we solve problems in this field [2] (Fig. 1).
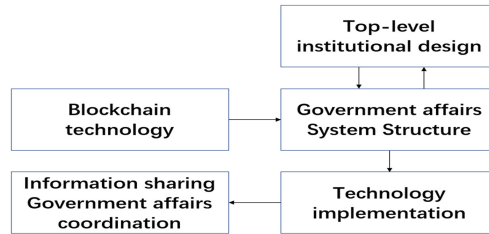
Fig. 1. The logical relationship between blockchain and government information sharing. Photo credit: Original

Taking the social security field as an example, it involves the coordinated management of multiple departments such as human resources and social security, finance, taxation, and civil affairs. The intercommunication and data integration of the information systems of different departments are the prerequisites for the collaborative management of government affairs among various departments. Apply blockchain technology to government system integration and information sharing, and build a public sector collaborative service platform, so as to improve the efficiency of government services, improve the level of public services, and achieve better convenience services.

2 Basic Theory

Blockchain technology is a collection of technologies that enables all participants in the system to collaborate, collectively record and maintain a reliable database through decentralization and encryption technology under the premise that many subjects use the consensus mechanism to achieve mutual trust among multiple parties. Blockchain technology can record and save the information generated by any number of individuals participating in the consensus mechanism within a period of time through an encryption algorithm into a data block, and then generate the exclusive password for the data block, which is used to connect the data chain. Each subject can also conduct cross-validation to jointly verify the authenticity of the information to ensure the authenticity and accuracy of the data on the blockchain [5]. Blockchain technology is considered to be the next-generation disruptive core technology of the steam engine solves the productivity problem, electricity corresponds to energy conversion, the Internet corresponds to information transmission, and the blockchain has a fundamental subversion to building trust (Fig. 2).

The main characteristics of blockchain technology are mainly summarized from three aspects: organization, technology and value. In terms of organizational form, blockchain is a chained data structure, and the organizational form of blockchain is a chained data structure formed by connecting data blocks in the chronological order of formation, and cryptographically ensures that it will not be Tampering, not being forged. The blockchain uses timestamp, hash value verification and other technologies to connect the blocks with data in chronological order to form a block chain structure with clear order. The essence is to follow the chronological order. A database of records, so blockchain has strong verifiability and traceability.
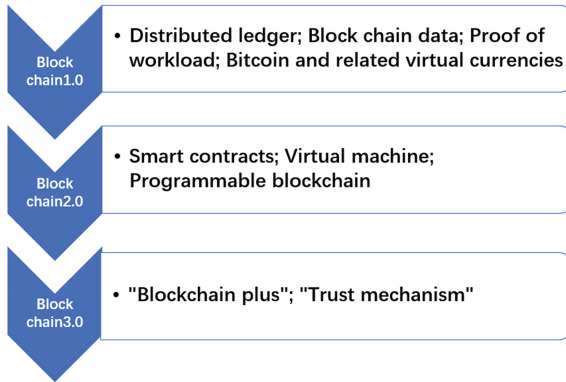
Fig. 2. Stages of blockchain technology development. Photo credit: Original

From the technical point of view, the blockchain is a distributed database, and decentralization is its biggest feature. Unlike the traditional centralized database, the blockchain itself is composed of any network nodes participating in the consensus mechanism of the whole network. The data in the blockchain is stored in a shared database composed of different nodes. There is no so-called centralized database support, and all information and behaviours are supervised by the entire network. The notarized ledger of the entire network makes it possible that even if one of the nodes is attacked or tampered with, it will not affect other nodes, and the attack cost is extremely high. Only one party can attack with 51% of the computing power of the entire network [3].

From a value perspective, blockchain is a credit mechanism. Blockchain technology minimizes the factors of human influence, maximizes the pre-set rules and terms between machines, and is a programmable contract [1]. Once the data on the blockchain is formed, it will be broadcast by the entire network and updated to the entire network synchronously. Any node on the blockchain has the right to query the data information stored on the entire blockchain. Due to the openness of the blockchain, as long as it meets the set conditions, it can be added to the blockchain. Nodes can be added flexibly according to business scenarios and the needs of participating institutions.

The system synergy theory is an emerging discipline that was proposed and founded by the famous physicist Haken, a professor at the University of Stuttgart in the Federal Republic of Germany in the 1970s. It was gradually formed and developed on the basis of multidisciplinary research. It is an important branch theory of systems science. The core problem of theoretical research is the relationship between the whole and the part. In terms of the type of system collaboration, the methods of system collaboration include: data integration, application system integration, and business process integration. The introduction of the system coordination theory into the field of public management has produced a new concept of coordinated government affairs. Collaborative government affairs refer to a new type of government work mode that uses modern information technology among government organizations to maximize the utilization of government resources and weaken the information barriers between organizations to change the traditional collaborative mode. The application of system collaboration theory to the

real society is to coordinate the interests of all parties to the greatest extent, to achieve full utilization of resources and continuous optimization of resource allocation, and to apply it to e-government is to promote the integration of heterogeneous information resources, optimize work processes, and build a scientific and efficient work system. Improve the level of public governance and improve the efficiency of public services.

Aiming at the problem of data dispersion in the process of government affairs collaboration, by using blockchain technology to plan and construct a cross-departmental information sharing collaborative processing platform based on information resources, it can effectively solve the problems of data security and reliability, tracking data usage and other issues [4].

3 Materials and Methods

With the introduction of computer technology into government affairs processing, it has experienced a certain scale of development for decades, but the problem of independence and "information islands" has become more and more prominent. In order to better realize the data sharing and coordinated development of the e-government system, the government The department has also tried solutions such as database middleware and email, but the results have not met expectations. Nowadays, government affairs coordination is mainly faced with three problems: data security, platform main body expansion, and data use specification. In response to the above problems, it is necessary to reform and innovate the previous data sharing system, from a relatively parallel independent single vertical information transmission platform to a cross-integrated information platform. Fully integrate the existing information resources, dig deep, integrate and develop, build a new platform for government affairs collaboration, efficient and flexible e-government affairs based on the exchange and sharing of data resources, and promote the further optimization and upgrading of the e-government affairs system. The theoretical assumption of the blockchain information sharing government collaboration platform architecture is shown in Fig. 3.

The blockchain information sharing government collaboration platform architecture includes three levels: application layer, data sharing layer, and business management layer.

The application layer mainly faces the information input parties such as legal persons and natural persons to realize the collection of information based on the data sharing platform, and conduct research and analysis on the coordination of government affairs on the basis of the information. Based on the sharing of the blockchain government data platform, break the information barriers between different functional departments, establish an integrated inter-departmental collaborative work mechanism, and work with social security-related departments such as people's livelihood security, public services, social assistance, pension medical care, etc. The data provider builds the information connection pathway. Establish a digital identity for each natural person, legal person, etc., conduct auditing, analysis and data mining of individuals based on information to establish personal government affairs files, use information to better meet their own needs, and better restrict their behavioural norms.

The data sharing layer is the most critical part of the blockchain information sharing and government affairs collaboration platform. According to the particularity of the
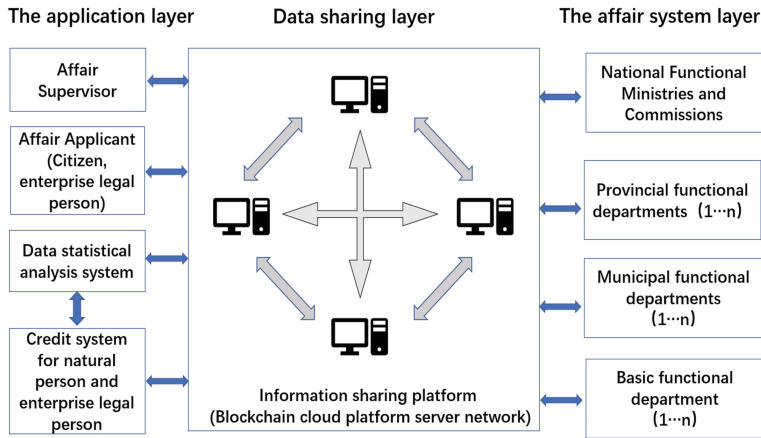
Fig. 3. Collaborative innovation platform architecture based on blockchain. Photo credit: Original

government affairs system itself, the platform is realized in the form of a combination of alliance chain and private chain. The deployment of blockchain nodes is based on the cloud platform and the server. Set up the construction situation. After each government system is connected to the blockchain, it becomes a node of the blockchain, promotes information and data resources on the chain, and establishes a data resource directory. Based on digital identity and corporate legal person data as a link to establish a government data sharing platform with the blockchain system, a secure network topology is designed to maximize the goal of data sharing and enable the government data sharing platform to operate in a safe, reliable and efficient system., to ensure the smooth operation of the government affairs system and the blockchain system.

The business management includes the information system directly managed by the state and the information system built by local functional departments. For example, the "Golden Insurance Project" in the field of social security has accumulated a large amount of information and data resources. Due to the particularity and sensitivity of government information data, it is necessary to remove sensitive information to varying degrees according to the degree of confidentiality, so that sensitive information can be converted into non-sensitive and public information. Then upload the blockchain to ensure that the government information data on the blockchain is open and available to the public.

4 Results and Discussion

For the construction of innovative applications of blockchain-based digital identity authentication, the overall architecture design of blockchain technology applications is crucial. Based on the scenario of digital identity to discuss the research on government affairs information data sharing and government affairs collaborative innovation, the core research content is to use individual digital identity as a carrier to coordinate the data in the existing system, so as to realize the coordination of information data in the government affairs system, and then develop a new innovative application (Fig. 4).
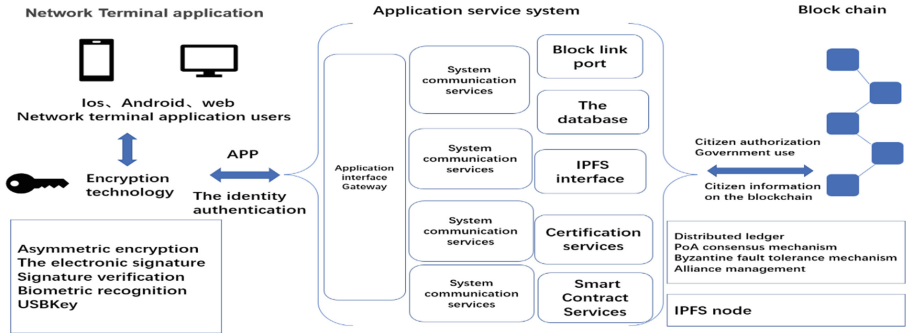
Fig. 4. Blockchain-based digital identity authentication architecture diagram. Photo credit: Original

The front end is a network terminal application. Individuals such as citizens use mobile terminals such as mobile phones and PCs as carriers to upload existing physical identity certificates such as ID cards and social security cards to the corresponding government information system for verification and leave certificates in the system. When individual citizens need to use data, they can obtain personal data information accumulated in various departments by registering digital identity signature authentication through the supporting app, and the citizen data is kept in the blockchain; when government departments need to use citizens' personal information, only It requires the authorization of citizens to extract the existing information in the blockchain, without the need for citizens to re-upload physical documents to prove.

The middle is the application service system. According to the application requirements of the government service system and the blockchain, the government functional departments should transform the government affairs system and communication services, and encrypt and protect the transmitted government affairs data information. In order to better match the blockchain technology and the coordination of government affairs system, the development of IPFS interface, compared with HTTP web, it has the characteristics of distributed decentralization that is faster, safer, and more compatible with the technology of the blockchain itself, and provides the same simple interface as HTTP web. Due to the distributed nature of IPFS The characteristics of personal space data are stored in the IPFS of the blockchain, seeking the same file system connecting all computer devices. Unstructured large files such as images in various government systems are stored in IPFS, and the hash value of the file is extracted and uploaded to the blockchain. The data stored in the blockchain is traceable, immutable and features of cross-validation to ensure the uniqueness and accuracy of data shared on the blockchain.

The core part of the government system is the blockchain system, and the focus of the blockchain system is the consensus mechanism. By comparing the advantages and disadvantages of various consensus mechanisms and considering the characteristics of the government system, the consensus mechanism and fault-tolerant mechanism are selected and improved, the traditional Proof of Work workload proof mechanism is abandoned, and Proof of Authority and Proof Byzantine Fault Tolerance are adopted. Consensus fault tolerance mechanism combined with Fault Tolerance. Compared with

Consensus mechanism	Degree of decentralization	Ratio of fault-tolerant nodes	Application
PoW	Completely decentralized	51%	Bitcoin
PoA	Completely decentralized	51%	Copyright management in the cultural field
PBET	Semi-decentralization	33%	Central bank blockchain Digital bill trading platform

Fig. 5. Comparison of the characteristics of the three consensus mechanisms. Photo credit: Original

Proof of Work, the Proof of Authority consensus mechanism has the advantages of higher efficiency, lower energy consumption, and lower requirements for hardware resources in the government system. Using Proof Byzantine Fault Tolerance as a fault-tolerant mechanism can ensure the flexibility and security of the system to the greatest extent. In some special cases, the Coordinator/Commander or Member on the system may and exchange wrong information, resulting in affecting the final system consistency. The Byzantine Generals problem looks for possible solutions based on the number of faulty computers. Using PBFT, a blockchain network of (n) nodes can sustain (f) Byzantine problem nodes, where f = (n−1)/3. Using Proof of Authority as the consensus mechanism and PBFT as the fault-tolerant mechanism can ensure that the block generation speed is less than 1 s to meet the application requirements of the government system (Fig. 5).

On the basis of the digital identity authentication architecture based on blockchain technology, the realization of the digital identity function requires the following process operations. The chart shows the process of recording digital identity information on the blockchain. Citizen government affairs data is recorded on the blockchain. There is no need to submit paper certificates when handling business in government functional departments, but only need to authorize the network terminal to obtain information. The process is divided into four parts: registering digital identity, declaring user attributes, authenticating user attributes, accessing the system (using information) (Fig. 6).

1. Register digital identity: submit an application for identity creation, submit information to the server, and complete the creation on the blockchain system.
2. Declare user attributes: upload the user declaration attributes to the server, put the information into IPFS and store the hash value information of the information on the blockchain.
3. Authentication user attributes: submit to the authentication agency and store the authentication information on the blockchain.
4. Access to the system (use information): use network terminals such as mobile phones and pc to send user attribute information to the server through login portals such as URLs and QR codes, and the server obtains the information on the blockchain after verifying whether the information matches the blockchain information. User authentication information.
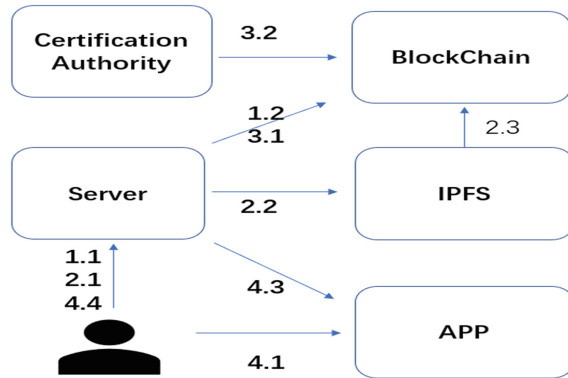
Fig. 6. The main functional flow of digital identity. Photo credit: Original

5 Conclusions

Blockchain technology makes cross-sectoral government affairs more efficient. The value of blockchain technology mainly reflects the function of "trusting the machine". It builds a trust relationship through technology, builds a data sharing mechanism based on data trust, and establishes an efficient inter-departmental collaboration system based on the data sharing mechanism. Establish an exclusive "credit file", that is, an individual credit evaluation system. Through blockchain technology, the original interpersonal trust and the trust mechanism between documents are converted to the level of data trust and technical trust, which greatly reduces the cost of establishing trust relationships, thereby improving government service capabilities and public governance in all aspects.

Constructing a linkage and collaborative government affairs system. Taking social security as an example, by linking functional business departments such as human resources and social security, finance, taxation, civil affairs, housing construction, medical care, poverty alleviation, assistance, etc., to build an efficient, flexible and collaborative government information linkage management platform, taking advantage of the platform to achieve information interconnection Interoperability, realizing cross-departmental linkage processing of common and cross-related affairs, transparent operation, office digitalization, whole-process supervision, data sharing and non-tampering, and use of new technologies to promote the realization of high-quality public services.

Citizens handle government affairs more efficiently and conveniently. After the blockchain technology is integrated into the government system, the rights of digital identity are transferred to individual citizens, and individuals have control over digital identity, and the collection of personal-related government affairs data is stored in the space of digital identity. Functional departments need Citizen data can be obtained by accessing the personal data identity space of citizens in the blockchain after the citizen's authorization. Citizens do not need to submit paper documents to functional departments to realize "doing business without leaving home". Conditional approval has become authorized to handle trust approval, and the government has also changed the government service model, from passive processing to active service, which conforms to the trend of the times for technology-assisted services. Taking the field of social

security as an example, the following government affairs can use blockchain technology to improve services, (1) issuance of participation certificate (2) endowment insurance qualification certification (3) work injury insurance qualification certification (4) medical insurance account information query (5) Social security relationship transfer registration (6) Skills training registration and other related services for laid-off workers can be handled quickly and efficiently through the blockchain information sharing system.

Environmental protection, low consumption, paperless office. Under normal circumstances, the cross-departmental government affairs approval process adopts the form of paper certificate + manual approval. After the blockchain technology is integrated into the government affairs system, because the blockchain technology has the technical characteristics of ensuring that the data can be traced and cannot be tampered with, the government business handlers And the approval personnel can complete the cross-departmental government approval work by adding electronic signature technology to the data stored on the blockchain, without the need for paper certificates and letter replies, which improves the ability of each department to work together, simplifies the work difficulty, and greatly improves cross-departmental approval.

Due to the rapid development of the government affairs system and the diversification and complexity of the main users, there are higher requirements for the functions of the government affairs system. Government information sharing is the result of the coordination and balance of multi-departmental subjects. Blockchain technology is another innovative reconstruction of the traditional government system after the Internet. In view of the problems of the traditional government system, combined with the emerging blockchain technology, the technical advantages are used to solve the problems of the system, and an innovative application of the combination of the two is proposed. Breaking the original information barriers through the government affairs data on the chain, using the digital identity of citizens as the scenario, constructing the application structure and process, multiple business systems collaborate across departments, improving the efficiency of government affairs processing, in realizing data collaboration, shaping a transparent government, play an active role in enhancing the credibility of government affairs. Similarly, in the application process of technology, it also faces many problems such as lack of talents, backward hardware equipment, resource consumption, etc.

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