Intelligent Agricultural Information Remote Data Storage Method Based on Block Chain

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Abstract. In order to improve the secure storage and fault-tolerant ability of intelligent agricultural information remote data storage system, a fault-tolerant method of intelligent agricultural information remote data storage system based on block chain is proposed. Combined with the statistical feature analysis method, the fault-tolerant characteristics of the intelligent agricultural information remote data storage system are analyzed, the correlation characteristics of the intelligent agricultural information remote data are extracted, the block chain control model of the intelligent agricultural information remote data is established, and the block storage and feature matching design of the intelligent agricultural information remote data is carried out by using the autocorrelation feature detection method. The block chain storage structure of intelligent agricultural information remote data security storage is established, combined with the optimized block chain control scheme, the optimal storage structure of intelligent agricultural information remote data is reorganized, the structure reorganization and feature reconstruction of intelligent agricultural information remote data are realized by using fuzzy clustering and vector quantification coding scheme, and the fault tolerant strategy optimization of intelligent agricultural information remote data storage system is realized. The simulation results show that the design of intelligent agricultural information remote data storage system based on this method has good fault tolerance and strong coding and decoding ability, which improves the security of intelligent agricultural information remote data storage and management.

Keywords: Block chain control · Intelligence · Agricultural information · Remote data · Storage

1 Introduction

With the development of the intelligent agricultural information system, the information management of the intelligent agricultural information remote data is greatly concerned, and it is necessary to construct the optimized storage and secure transmission system of the intelligent agricultural information remote data, the intelligent agricultural information remote data encryption and coding design is carried out in combination with the data coding method [1], the safety management capability of the intelligent agricultural information remote data is improved, and the network information encryption and coding design method of the intelligent agricultural information

remote data are researched, it has great significance to store and optimize the remote data of intelligent agricultural information. the information management of the remote data of the intelligent agricultural information is based on the fault-tolerant strategy optimization design of the storage system for the remote data of the intelligent agricultural information, and the fault-tolerant strategy of the intelligent agricultural information remote data storage system is constructed, promote the security management and storage of intelligent agricultural information remote data [2].

Based on the detection and feature extraction of intelligent agricultural information remote data, the fault tolerance design of intelligent agricultural information remote data is carried out, and the discrete big data analysis model of intelligent agricultural information remote data is constructed [3], the fault-tolerant design of the intelligent agricultural information remote data storage system is carried out by using a large data mining method. In the traditional method, the intelligent agricultural information remote data fault-tolerance storage design mainly comprises a vector quantization coding method, a fuzzy correlation scheduling method and a hybrid encryption method and the like, the intelligent agricultural information remote data storage design is carried out by adopting a block chain control method, and the safe transmission and storage performance of the intelligent agricultural information remote data are improved. The fault-tolerant design method of the intelligent agricultural information remote data storage system based on the feature space reconstruction is proposed in the paper [4], and the distributed characteristic sequence recombination of the intelligent agricultural information remote data is carried out, The statistic characteristic component of the remote data of the intelligent agricultural information is extracted to carry out the encrypted transmission scheduling, but the calculation cost of the method is large and the real-time property is not good. In the paper [5], the fault-tolerant strategy of the intelligent agricultural information remote data storage system based on the C-means clustering analysis is proposed, and the coding design of the intelligent agricultural information remote data is carried out by adopting the method of the self-adaptive fuzzy clustering analysis, but the self-adaptability of the method is not good, in view of the above problems, this paper proposes a fault-tolerant method of intelligent agricultural information remote data storage system based on block chain. Firstly, the fault-tolerant characteristic analysis of the intelligent agricultural information remote data storage system is carried out in combination with the statistical analysis method, and the correlation characteristic quantity of the intelligent agricultural information remote data is extracted, the optimized storage structure of the intelligent agricultural information remote data is reorganized in combination with the optimized block chain control scheme, and then the structure recombination and the characteristic reconstruction of the intelligent agricultural information remote data are realized by adopting a fuzzy clustering and vector quantization coding scheme. And the fault-tolerant strategy optimization of the intelligent agricultural information remote data storage system is realized. Finally, the simulation experiment is carried out to show the advantages of the method in improving the fault-tolerance performance of the intelligent agricultural information remote data storage system [6].

2   Intelligent Agricultural Information Remote Data Distributed Storage Structure Model and Feature Analysis

2.1   Intelligent Agricultural Information Remote Data Distributed Storage Structure Model

In order to optimize the fault-tolerant design strategy of intelligent agricultural information remote data storage system, firstly, the distributed storage structure of intelligent agricultural information remote data is analyzed, the TinySBSec coding system is embedded into multi-Hoffman table to optimize the coding design of intelligent agricultural information remote data, and the multi-distributed quantitative coding scheme is adopted [7]. The information coding model and statistical information detection model of intelligent agricultural information remote data are established, and the public key is embedded into the master key to carry out the design of intelligent agricultural information remote data distributed coding and block chain control. The intelligent agricultural information remote data distributed collection is constructed by wireless ZigBee networking protocol, and the information fusion of intelligent agricultural information remote data is carried out under the structure system of the Internet of things [8]. The fault-tolerant design model of intelligent agricultural information remote data storage system is constructed, and the quantitative coding of intelligent agricultural information remote data is carried out by using pseudorandom sequence. The collected remote data of intelligent agricultural information is stored optimally through local database and cloud database. The intelligent agricultural information remote data storage system model is shown in Fig. 1.
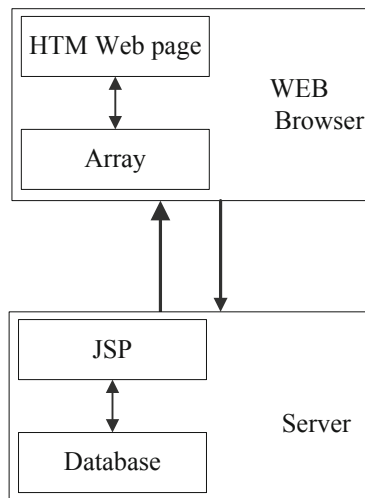

Fig. 1. Model of intelligent remote data storage system for agricultural information

A connected undirected graph $G = V, E, W$ is used to represent the coding center of the intelligent agricultural information remote data storage model, in which $V = \{v_1, v_2, \ldots v_N\}$ is the geometric feature distribution term of the intelligent agricultural information remote data, in which a_j, constructs the coding key agreement protocol of the intelligent agricultural information remote data in the finite field, inputs the key parameters, and obtains the association rule set of the intelligent agricultural information remote data represented by a_j. The simplified geometric model of fault-tolerant storage in intelligent agricultural information remote data storage system can be described by the following formula:

$$\begin{cases} G_1 = b_{11}a_1 + b_{12}a_2 + \ldots + b_{1n}a_n \\ G_2 = b_{21}a_1 + b_{22}a_2 + \ldots + b_{2n}a_n \\ \ldots \quad\quad\quad \ldots \quad\quad\quad \ldots \\ G_n = b_{n1}a_1 + b_{n2}a_2 + \ldots + b_{nn}a_n \end{cases} \tag{1}$$

Wherein, G_1 and G_2 indicate that fault-tolerant storage of intelligent agricultural information remote data storage system is related. G_n is the principal component characteristic quantity of intelligent agricultural information remote data coding. a represents the available capacity of the storage node; b represents the load threshold of the storage node. According to the above analysis, the distributed collection and storage structure model of intelligent agricultural information remote data is constructed [9].

2.2   Analysis of Correlation Characteristics of Intelligent Agricultural Information Remote Data

the intelligent agricultural information remote data storage system fault-tolerant characteristic analysis is carried out in combination with the statistical analysis method, the correlation characteristic quantity of the intelligent agricultural information remote data is extracted [10], the block chain control model of the intelligent agricultural information remote data is established, the probability density of the characteristic distribution of the intelligent agricultural information remote data state is obtained by adopting a sample fusion cluster analysis method:

$$w_{ij} = \beta \times w(e_p k_q) \quad (\beta > 1) \tag{2}$$

In which, β is the master key of intelligent agricultural information remote data coding sequence, and $w(e_p k_q)$ represents the length of cyclic shift, and the difference discriminant function of fault tolerance control of intelligent agricultural information remote data storage system is as follows:

$$\hat{W} = \begin{cases} \text{sgn}(W)(|W| - \alpha Ts) & |W| \geq Ts \\ 0 & |W| < Ts \end{cases} \tag{3}$$

Wherein, α is an adaptive adjustment coefficient of the fault-tolerant design of the intelligent agricultural information remote data storage system, W is the fuzzy state characteristic component of the intelligent agricultural information remote data, the value range is $0 \leq \alpha \leq 1$ extracting the correlation feature quantity of the intelligent agricultural information remote data, establishing a block chain control model of the intelligent agricultural information remote data, extracting the intelligent agricultural information remote data characteristic, combining the characteristic classification technology, the intelligent agricultural information remote data storage system fault-tolerant coding control is realized, and a fuzzy information coding model of the intelligent agricultural information remote data is established, and the intelligent agricultural information remote data erasure coding model is obtained as follows:

$$\min_{w,b,\xi} \frac{1}{2}\|W\|^2 + k(x_i, x_j)((W \cdot a) + b) + w(e_p k_q) \geq 1 \tag{4}$$

According to the coupling relationship of intelligent agricultural information remote data, the high dimensional phase space reconstruction is introduced, and the kernel function $k(x_i, x_j)$, which is fault tolerant design of intelligent agricultural information remote data storage system, is obtained. The multi-resolution function of intelligent agricultural information remote data monitoring is as follows:

$$\left.\begin{aligned} \min_{\alpha} & \frac{1}{2}\sum_{i=1}^{l}\sum_{j=1}^{l} y_i y_j \alpha_i \alpha_j K(x_i, x_j) - \sum_{j=1}^{l} \alpha_j \\ s.t. \quad & \sum_{j=1}^{l} y_j \alpha_j = 0 \\ & 0 \leq \alpha_j \leq u(x_j)C, \qquad j = 1, 2, \ldots, l \end{aligned}\right\} \tag{5}$$

The intelligent agricultural information remote data storage system fault-tolerance transfer function is obtained by adopting a bit sequence modulation method to realize the public key output control of the intelligent agricultural information remote data:

$$h(t) = H \sum_{m=1}^{M} \sum_{k=1}^{K(m)} \alpha_{mk} \delta(t - T_m - \tau_{mk}) \tag{6}$$

Combined with the above feature extraction results, the fuzzy cyclic shift method is used to cluster the information of intelligent agricultural information remote data, and the correlation features of intelligent agricultural information remote data are detected [11].

3   Intelligent Agricultural Information Remote Data Storage System Fault Tolerance Strategy

3.1   Block Chain Control Algorithm

On the basis of analyzing the fault-tolerant characteristics of intelligent agricultural information remote data storage system and extracting the correlation characteristics of intelligent agricultural information remote data storage system, the fault-tolerant strategy of intelligent agricultural information remote data storage system is optimized. As a distributed architecture, blockchain provides a new solution for privacy protection and data sharing, which is an extremely hot research direction. Using the block chain technology in the intelligent agricultural information remote data collection base station, the intelligent agricultural information remote data storage alliance chain (DSCB) system is formed. Data sharing among nodes in DSCB is completed by smart contract. Data owners set constraints on data storage, and use computer language instead of legal provisions to regulate the behavior of data visitors, so as to achieve decentralized collective maintenance of a safe and reliable data storage database. In this paper, a fault-tolerant method of intelligent agricultural information remote data storage system based on block chain is proposed. The metadata structure characteristics of intelligent agricultural information remote data are extracted, and the fault-tolerant control of intelligent agricultural information remote data storage system is carried out by using the method of source coding design. The statistical analysis model of fault-tolerance of intelligent agricultural information remote data storage system is obtained.

$$\frac{\partial u_i}{\partial p_i} = \frac{Gh_i}{\sum\limits_{j \neq i} h_j p_j + \sigma^2} \left(\frac{1}{1 + \gamma_i} - \beta_{c_1} \right) \tag{7}$$

The block chain storage structure of intelligent agricultural information remote data security storage is established. Combined with the optimized block chain control scheme, the optimal storage structure of intelligent agricultural information remote data is reorganized, and the non-orthogonal multiple access control of intelligent agricultural information remote data is carried out. The block chain control components of intelligent agricultural information remote data are obtained as:

$$\eta_{comm} = \frac{k_1 \cdot l}{E_{comm}} \cdot \left(1 - p_{drop} \right) \tag{8}$$

Among them, p_{drop} is the symbol output bit sequence of intelligent agricultural information remote data, the output shift symbol $CH_i(i \in C_1)$, which is used to extract the metadata structure characteristics of intelligent agricultural information remote data, and the dynamic load balancing scheduling method is used to carry out the adaptive coding of intelligent agricultural information remote data. The output is as follows:

$$f(x) = \text{sgn}\{\sum_{j=1}^{l} p_{drop}\alpha Kk(x_i, x_j) + b\}, x \in R^n \tag{9}$$

Wherein, $b^* = y_i - \sum_{j=1}^{l} y_j\alpha_j K(x_j, x_i)$, $i \in \{i\big|0<\alpha_i^* <u(x_i)C\}$.

The nearest neighbor query in the process of intelligent agricultural information remote data protection is carried out by using the method of phase space reconstruction. The privacy block chain control output of intelligent agricultural information remote data can be defined as follows:

$$V(u_i) = \left\|\frac{dP(u)}{dt}\right\|_{u=u_i} = \left\|\frac{dP(u)}{dt}\right\|_{u=u_i} \frac{du}{dt}|_{t=t_i} \tag{10}$$

Then

$$\frac{du}{dt}|_{t=t_i} = \frac{V(u_i)}{\left\|\frac{dP(u)}{du}\right\|_{u=u_i}} \tag{11}$$

Ignoring the high order trace H.O.T in the coding process, using the method of fuzzy correlation scheduling, we can get the block chain storage structure increment Δu_{i+1} of intelligent agricultural information remote data security storage:

$$\Delta u_{i+1} = u_{i+1} - u_i = \frac{V(u_i) \times T_s}{\left\|\frac{dP(u)}{u}\right\|_{u=u_i}} = \frac{F \times T_s}{\sqrt{x'^2 + y'^2 + z'^2}} \tag{12}$$

T_s is the curve interpolation period. Based on the analysis, fuzzy clustering and vector quantification coding scheme are used to realize the structure reorganization and feature reconstruction of intelligent agricultural information remote data, and the block chain control of fault-tolerant design of intelligent agricultural information remote data storage system is realized [12].

3.2 Intelligent Agricultural Information Remote Data Storage Security Optimization

In combination with the optimized block chain control scheme, the optimized storage structure of the intelligent agricultural information remote data is reorganized, the intelligent agricultural information remote data is reorganized by the fuzzy clustering method, the data encryption design is carried out, and the N_{ik} is a k-times standard B-spline basis function, according to the fault tolerance control, the intelligent agricultural information remote data optimized and encrypted output is as follows:

$$N_{i,k} = \frac{(u - u_i)N_{i,k-1}(u)}{u_{i+k} - u_i} + \frac{(u_{i+k+1} - u)N_{i+1,k-1}(u)}{u_{i+k+1} - u_{k+1}} \tag{13}$$

The $U = \{u_0, u_1, \ldots, u_{n+k+1}\}$ in the above formula is a feature quantitative set of intelligent agricultural information remote data blockchain control symbol combination feature set, and u is a quantitative coding information distribution independent variable of intelligent agricultural information remote data.

Based on the method of spatial confusion and reorganization, the state characteristics of fault-tolerant encryption of intelligent agricultural information remote data are obtained as follows:

$$
\begin{aligned}
\beta_i^c &= -\sum_{k \in S_s} R_{ik} Q_{kc} - R_{i1} y_c \\
&= -\frac{1}{\det(Q')} \left(\sum_{k \in S_s} (-1)^{i+k} \det\left(Q'_{\backslash ki}\right) Q_{kc} + y_c(-1)^{i+1} \det\left(Q'_{i1}\right) \right)
\end{aligned}
\tag{14}
$$

In summary, the vector quantification coding scheme realizes the structure reorganization and feature reconstruction of intelligent agricultural information remote data, improves the security of data storage, and the implementation flow is shown in Fig. 2.
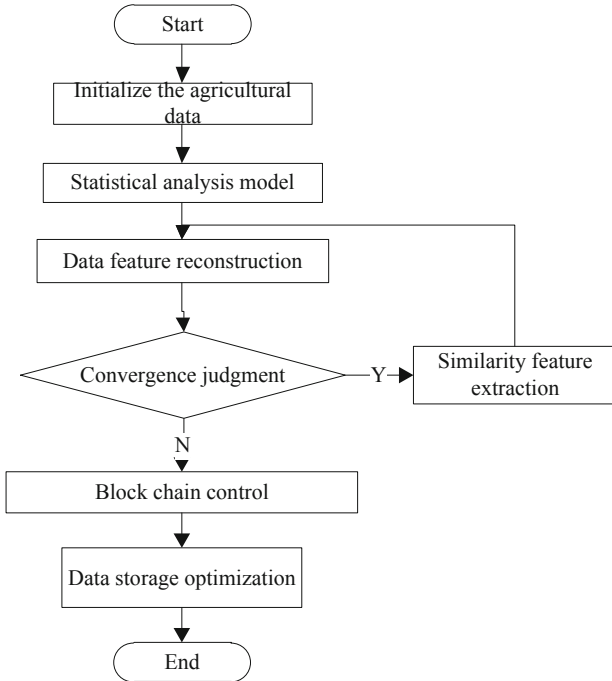

Fig. 2. Fault-tolerant optimization of intelligent agricultural information remote data storage system

4   Simulation Experiment and Result Analysis

In order to verify the performance of this method in the implementation of fault-tolerant control and erasure coding of intelligent agricultural information remote data storage system, combined with MATLAB, simulation experiments are carried out under the environment of VS2010 + opencv2.4.13, windows 10 operating system Intel (R) Xeon (R) CPU e5-2603v4 @ 2.20 GHz, and memory of 32 GB. Set the sampling length of remote data information of intelligent agricultural information as 1024, the test symbol sequence length of data coding as 100, the test symbol sequence length of data coding as 100, the number of training symbols as 500, and the number of iterations as 1000. In the remote data correction and deletion coding of intelligent agricultural information, the length of each group of plaintext blocks is 10000. According to the above simulation parameters, the intelligent agricultural information remote data storage coding is carried out, and the original intelligent agricultural information remote data is obtained as shown in Fig. 3.
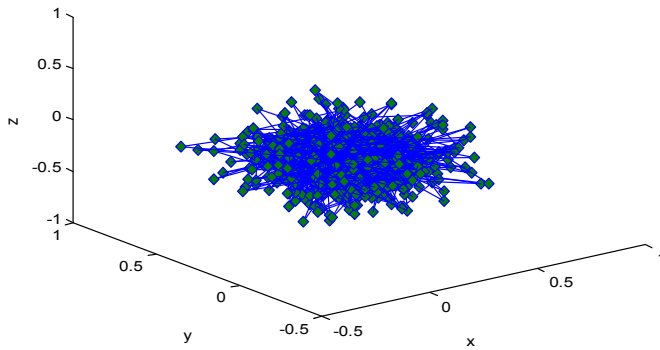

Fig. 3. Remote data of original intelligent agricultural information

Taking the data of Fig. 3 as the study sample, the block storage and feature matching design of the intelligent agricultural information remote data is carried out by adopting the self-correlation characteristic detection method, and the optimized coding output is shown in Fig. 4.
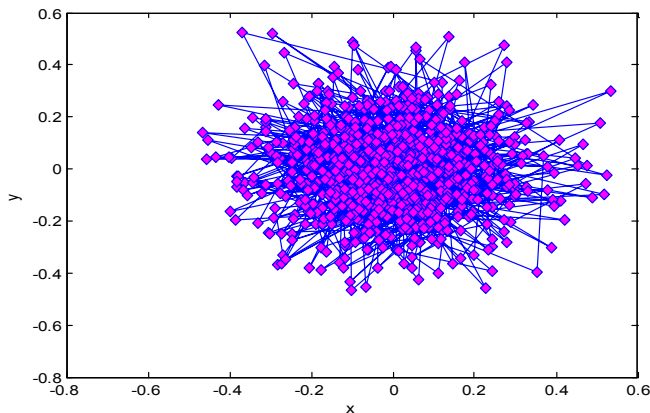
Fig. 4. Optimized code output for medical data

The analysis Fig. 4 shows that the output performance of the intelligent agricultural information remote data block chain control is better by adopting the method, the safe storage capacity of the data is improved, the fault tolerance of the data coding is improved, the comparison result is shown in Table 1.

Table 1. Intelligent agricultural information remote data storage optimization result

Data/Kbit	Proposed method	Chaotic coding	PSO	GP
1000	0.954	0.834	0.823	0.812
2000	0.987	0.858	0.845	0.834
3000	0.991	0.899	0.869	0.868
4000	0.998	0.921	0.884	0.887

According to Table 1, this paper has a good fault tolerance for intelligent agricultural information remote data storage.

In order to further verify the effectiveness of the method in this paper, the computational complexity of the method in this paper and the traditional method are compared and analyzed, and the comparison results are shown in Fig. 5.

According to Fig. 5, the calculation complexity of the method in this paper is up to 28%, which is lower than that of the traditional method, saving calculation time and improving storage efficiency.
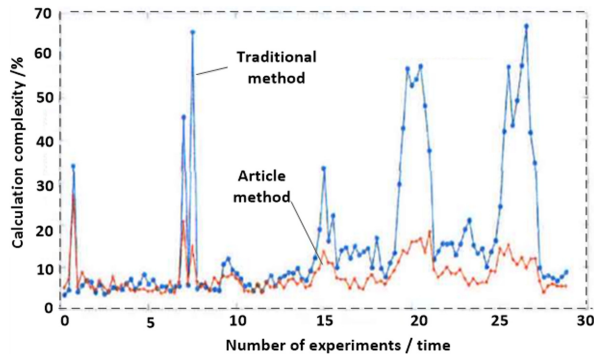
Fig. 5. Comparison results of computational complexity between the two methods

5 Conclusions

Combined with the data coding method, the encryption and coding design of intelligent agricultural information remote data is carried out, and the security management ability of intelligent agricultural information remote data is improved. In this paper, a fault-tolerant method of intelligent agricultural information remote data storage system based on block chain is proposed. The fault-tolerant characteristics of intelligent agricultural information remote data storage system are analyzed by statistical feature analysis method. Fuzzy clustering and vector quantification coding scheme are used to realize the structural reorganization and feature reconstruction of intelligent agricultural information remote data. Based on the method of spatial confusion recombination, the state feature distribution of intelligent agricultural information remote data fault-tolerant encryption is obtained. The fault-tolerant strategy optimization of intelligent agricultural information remote data storage system is realized. It is found that this method can improve the coding ability of intelligent agricultural information remote data and improve the fault-tolerant performance of secure storage.

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