Blockchain-Based Identity Authentication and Intelligent Credit Reporting

Xingxiong Zhu¹,²,³*
¹State Grid Power Finance and E-Commerce Laboratory, Beijing 100053, China
²State Grid Electronic Commerce Co., Ltd., Beijing 100053, China
³State Grid Xiong'an Financial Technology Co., Ltd., Beijing 100053, China
*E-mail: zhuxx@pku.org.cn

Abstract. This paper elaborates on the blockchain-based identity authentication and intelligent credit reporting method. The technologies of multidimensional authentication, multifactor weighted score calculation, security threshold, distributed ledger, smart contract and encryption algorithm are proposed to realize dynamic identity security authentication and intelligent risk control. The user behaviour analysis system, real-time risk identification system and intelligent risk prevention system are constructed. The multidimensional credit data collection is realized through blockchain distributed nodes. The distributed ledger of credit reporting, intelligent pricing of assets and automatic credit rating of users are proposed. It realizes credit reporting system and service based on multidimensional data, distributed ledgers, and smart contracts.

1. Introduction
In e-commerce, financial services, and energy applications, traditional identity authentication utilizes user password authentication or one type of biometric authentication¹-². Which is vulnerable to hacker attacks and security breaches, and lacks of system security. The insecurity of traditional biometric identity authentication is that biological characteristics is unchanged for many years and accompanying people's lifetime. Once the leak occurs or the system database is attacked by hackers, information security risk is seriously threatened. The traditional system lacks data security and authentication intelligence.

The credit reporting system is important foundation for e-commerce, financial services, and energy applications³-⁴. Building credit reporting system based on blockchain smart contract technology is conducive to ensuring financial security and enhancing the core competitiveness of the system. The current credit reporting system lacks multidimensional data covering the power industry's transaction data, power finance data, and user’s electricity fee data. How to broaden the coverage of credit evaluation, improve the accuracy of credit evaluation, ensure data security and privacy protection has become urgent problems to be solved.

This paper proposes credible security identity authentication methods and intelligent credit reporting mechanisms for e-commerce, financial services and energy applications.

2. Blockchain-based identity authentication
The intelligent dynamic identity authentication method and system are constructed by integrating biometrics, behavioural feature recognition technology and cryptography algorithms.
Biological characteristics includes face, fingerprint, retina, iris, voiceprint, palm print, vein, DNA, etc.

Behavioural characteristics includes gait, signature, voice, keystroke, etc.

The biometric feature and behavioural feature are associated with user key. The user key is generated from the user’s feature information.

Dynamic identity authentication and risk control are realized by using multidimensional authentication, multifactor weighted score calculation, security threshold, distributed ledger, smart contract, and encryption algorithm technology etc.

2.1. Key technologies

The user feature model is established by utilizing user's multidimensional biometric and behavioral features. An identity authenticity real-time feedback technology based on user dynamic behavior characteristics is used to construct an authentication technology for real-time detection of user terminal behavior. Based on the characteristics of interactive end-user behavior collection, analysis and processing, a network identity system based on legal identity is constructed.

The method and system for analyzing features is based on time, space, and behavior. The user feature authentication system is constructed for the business scenario, based on the user feature security authentication model and association analysis method.

Based on the blockchain-based distributed ledger, the user feature information is stored in the blockchain platform, which cannot be tampered with, and the data record can be traced.

It constructs intelligent risk control system by using blockchain technology, big data analysis and artificial intelligence technology. Based on user identity authentication data, account risk prediction and control system is constructed. It realizes user access behavior analysis, real-time risk identification and intelligent prevention and control system. Through risk control smart contracts, the system prevents risks such as garbage registration, malicious order placement, brute force cracking and smashing wool, and achieves intelligent risk control.

2.2. System Model

The method of user identity authentication is multidimensional, including biometric feature, behavioral feature, and user key authentication. The user feature information is associated with the user key, and the user key is generated from the feature information.

In the initialization and user registration phase, the user biometric files, behavioral information files, and hash values are stored in blockchain, which is tamperproof. When authentication is required, the currently obtained user feature information is compared with information previously collected at the time of registration.

For each dimension of identity authentication, such as face, fingerprint, retina, iris, voiceprint, palm print, vein, DNA, gait, signature, voice, keystroke, etc., is respectively assigned weight \( W_j \). The higher the confidence level of the authentication method, the higher weight is assigned.

Each time the certification is performed, the user's scoring of each dimension is quantified. User \( i \)'s authentication score in dimension \( j \) is \( A_{ij} \). Comprehensive weighted average score \( S_i \) of user \( i \) is calculated. The calculation method is shown in formula (1).

\[
S_i = \frac{\sum_{j=1}^{n} (A_{ij} \times W_j)}{\sum_{j=1}^{n} W_j}
\]

The user's individual each dimension identity authentication score \( A_{ij} \) and the final identity authentication comprehensive weighted average score \( S_i \) are stored in the blockchain distributed ledger.

The dynamic identity authentication smart contract is prebuilt. The minimum threshold of the identity authentication comprehensive weighted average score is set. When the application system needs to authenticate the user, it triggers the dynamic identity security authentication smart contract. It compares the user's current identity authentication comprehensive weighted average score with the lowest score
threshold. If the user's comprehensive weighted average score is higher than the threshold, the authentication is passed, otherwise the authentication fails.

The system performs big data analysis on the user's historical authentication data, and uses artificial intelligence algorithms to discover abnormal user behavior and implement risk control.

3. Intelligent credit reporting based on blockchain
The development of Internet finance and big data technology has made a significant leap in the amount of information collected by credit reporting agencies, but accurate credit evaluation also needs to guarantee the data quality. It ensures that the credit data is true and valid, and the data is not leaked or falsified. Based on blockchain technology, the credit data is transparent, open, sharing and privacy protection.

The blockchain technology provides the core technical foundation, and supports the credit reporting system construction. The information of participant involved in the financial project is shared to solve the problem of information asymmetry and improve trust. The blockchain-based credit system guarantees the data can be traced back.

The system reduces the participation of intermediaries, weakens the role of intermediaries in the transaction process, realizes real-time confirmation and monitoring, and effectively reduces costs in all aspects of transactions. The credit reporting system based on blockchain technology improves cost structure, improves profitability, and reduces credit risk. It integrates industry information advantages and blockchain technology features, and enhances core competitiveness.

3.1. Key technologies
- Credit reporting systems and services are based on multidimensional data, distributed ledgers, and smart contracts.
- Multidimensional credit data collection is through the blockchain distributed nodes.
- Blockchain-based credit data is stored in distributed ledger.
- Credit rating smart contract achieves automatic credit rating.
- It builds a credit whitelist and blacklist sharing alliance based on the blockchain.

3.2. Multidimensional credit data
- Data of electricity fee payment: including payment user, electricity fee amount, payment time, etc.
- Data of electricity transaction: including transaction user, trading commodities, trading volume, transaction amount, etc.
- Internet financial data: including financing user, financing amount, financial institutions, financing time, etc.
- Power system data: including power user, power user number, user category, power consumption, etc.
- Industry data: including industry user, business, tax, justice, intellectual property and other information.

3.3. Distributed ledger
The system uses blockchain technology to solve the problem of data credibility. The data of user information, transaction, and operation is written into the blockchain, and is broadcasted and monitored by the entire network. For example, in financial services, the data of user verification, transaction approval, online publishing, lender information, borrower license, borrower commitment, contract signing, transaction processing, repayment information, clearing and settlement [10], etc., will be stored in the blockchain distributed ledger.

Data collection is required from multiple nodes during the crediting process. The data in blockchain includes two types, one is data directly recorded on the blockchain, and the other is data hash recorded on the blockchain. The original data is saved to the local database, whereas, the hash value is submitted
to blockchain for storage. Which avoids core business data leaking. The system verifies the consistency of the original data, and ensures that the credit data has not been tampered with.

The username on the blockchain, represented by a string of characters, is anonymized to protect user privacy from disclosure.

3.4. Credit reporting based on smart contract
The smart contract based asset assessment technology is used to define the credit risk level for individuals and enterprises. The asset obtains liquidity support.

In the credit reporting of financial services, the basic principles are mainly concerned with the solvency of individuals and enterprises, the willingness to pay debts, and the external support available. The system utilizes blockchain smart contracts to realize risk asset pricing.

Through the verification of the practice data of the business platform, the credit scoring model is verified by a large amount of data, and then upgraded to a practical credit scoring and reporting model based on blockchain technology.

3.5. System Model
The credit system architecture based on blockchain technology includes blockchain service layer, blockchain application programming interface layer, and application of credit system.

The alliance chain is established between the institutions and enterprises. The data of each platform is shared to provide multidimensional credit reporting. It uses blockchain technology to improve the traceability, sharing and security of credit data.

It constructs blockchain alliance chain to realize whitelist and blacklist sharing. Which is used as reference for the credit reporting business, and plays an important role in risk control. The white list of credit is a list of reputable individuals and businesses. Whereas, the blacklist of credit is a list of individuals and businesses that are untrustworthy.

4. Conclusion
This paper elaborates on the blockchain-based identity authentication and intelligent credit reporting method.

The technologies of multidimensional authentication, multifactor weighted score calculation, security threshold, distributed ledger, smart contract and encryption algorithm are proposed to realize dynamic identity security authentication and intelligent risk control. The user behaviour analysis system, real-time risk identification system and intelligent risk prevention system are constructed. The system performs big data analysis on the user's historical data, and uses artificial intelligence algorithms to discover abnormal user behaviour and implement risk control.

The multidimensional credit data collection is realized through the blockchain distributed nodes. The distributed ledger of credit reporting is constructed. The intelligent pricing of assets and automatic credit rating of users are proposed based on smart contracts. The system realizes credit reporting system and service based on multidimensional data, distributed ledgers, and smart contracts. It improves process efficiency, saves costs, and enhances core competitiveness.

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Author introduction
Xingxiong Zhu received the master degree in software engineering from Peking University, China in 2005. He was one of the main drafters of China National Standard GB/T 25656-2010, Information Technology Specification for Chinese Linux Programming Interface. Email, zhuxx@pku.org.cn.
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