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Application of Big Data in Digital Currency and Blockchain Finance

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Abstract: With the rise of emerging economic models, the cryptocurrency system, centered on the internet and electronization, is gradually returning to its core functions — storage, data processing, and related services. The deep value of massive data lies in rapid mining to uncover its inherent patterns, which is not only crucial for the operation, regulation, and monetary policy implementation of cryptocurrencies but also serves as an essential support for the transition from paper money to digital currencies. Given this, this research plans to conduct a detailed exploration of the application of big data in the field of cryptocurrency and blockchain finance, aiming to contribute to the continuous progress of China's financial industry.

Keywords: Big data; Digital currency; Blockchain finance

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1. Introduction

With the rapid advancement of information technology, behaviors such as online shopping and social media interactions have surged, resulting in massive amounts of data resources. By sorting out and analyzing the chaotic state of these vast datasets, researchers can extract valuable information and apply it to various areas of daily life and workplace activities. In this context, blockchain technology, as an innovative form of technology, has gradually emerged and is increasingly showing its influence. Especially in the field of bank loans, it is leading social and financial transactions towards a new historical stage [1].

2. Overview of blockchain and big data

2.1. Characteristics of blockchain

Blockchain technology is mainly divided into three categories: public chain, consortium chain, and private chain. They each possess characteristics such as openness, security, traceability, and chronological ordering.

Public Chain: This type of blockchain has no official management body, and anyone can freely join and use it. The node network is open to all, typically employing a Proof of Work consensus algorithm where all nodes participate in the consensus process. Anyone can access the public chain, conduct transactions, and receive verification, while also having the right to participate in consensus decision-making.

Consortium Chain: Joining this chain requires identity verification. Certain nodes of the consortium chain are controlled by alliance members, thanks to its unique consensus mechanism. For instance, multiple financial institutions can jointly construct a consortium chain to facilitate information sharing among members.

Private Chain: Also known as a proprietary chain, it is an independent blockchain used internally by specific organizations. Only the organization has write permissions for the blockchain, while read permissions are restrictively open to the outside [2].

2.2. Characteristics of big data

Within a specific time frame, it is difficult for conventional devices to collect vast amounts of information, and this collection of information is called big data. According to IBM's definition, big data possesses "five V's" characteristics:

Volume: Big data involves an extremely large amount of information. Whether it's collection, storage, or retrieval, the scale is exceptionally huge, often measured in Petabytes (equivalent to 1000 Terabytes).

Variety: Big data comes from a wide range of sources and covers multiple types of information, including structured data like numbers and text, as well as unstructured data like voice and map data. The diverse forms of these data pose higher challenges to data processing techniques.

Value: The value density contained in big data is not high. How to tap into the value of this data for specific business needs, utilizing machine learning, and artificial intelligence combined with manual analysis, has become an urgent problem to solve.

Velocity: The amount of data is rapidly growing every day, which places higher demands on the efficiency of data processing.

Veracity: The quality of data, namely its accuracy and reliability, is another crucial dimension to consider in big data [3].

2.3. Application analysis of big data in digital currency

Big data computing data processing methods in the field of big data mainly fall into two modes: batch processing and stream processing. Batch processing focuses on the pre-storage of data, followed by centralized processing of the stored fixed data. This mode is typically applied in situations where real-time data requirements are not high, but data integrity and accuracy are critical [4]. Conversely, stream processing faces uncertain arrival times and sequences of data, making comprehensive data storage impractical. Therefore, it omits the storage step and directly processes real-time arriving data in memory. This mode is suitable for environments with extremely high real-time requirements and relatively low data accuracy demands. Hadoop, as a representative big data batch processing framework, utilizes the HDFS distributed file system to store static data and distributes computing tasks to various data nodes through MapReduce for data processing and value mining. Meanwhile, Twitter's Storm and Yahoo's S4 are typical examples of stream data processing frameworks [5].

In the financial industry, batch processing technology is widely used to build enterprise-level data warehouses, enabling integrated storage of internal and external data. Through analytical modeling of business

data, more data correlations are discovered, providing data support for decision-making and precision marketing, and further promoting business optimization and innovation. Stream processing technology can process massive amounts of data in real time, assisting financial institutions in addressing various financial fraud risks, executing real-time intelligent decision-making, and predicting customer consumption behavior. Additionally, financial institutions leverage deep learning technology, harnessing the powerful capabilities of artificial intelligence in areas such as image recognition, speech processing, and natural language understanding to achieve technological leaps, integrate broader data resources, predict the behavior of financial consumers, and effectively enhance the efficiency of marketing and risk management [6].

2.4. Infrastructure construction

From the temporal dimension, it is necessary to collect and organize core basic data throughout the entire lifecycle of digital currencies, from their emergence to demise. This lays a solid foundation for subsequent model building, simulation experiments, deep analysis, and effective management. In terms of spatial dimensions, creating a distribution map of digital currency activity trajectories accurately depicts the circulation scale, specific locations, and time nodes of legal digital currencies. Spatial positioning is also performed to construct a real-time map of the dynamic distribution of digital currencies, thereby intuitively grasping the circulation scope and key deployment areas of digital currencies and providing data support for precise decision-making [7]. Regarding system architecture design, emphasis should be placed on the stability and scalability of the big data infrastructure. The structure should be divided into a data layer, an interface layer, a service layer, and an application layer, ensuring strong security, flexibility, and necessary openness in data collection, analytical model construction, and application interface design.

2.5. Scientific selection of digital currency analysis indicator system

When evaluating the core aggregate indicators and price dynamic indicators of digital currencies, it is essential to conduct an in-depth analysis from four perspectives: visibility, manageability, relevance, and durability. Additionally, simulation studies should be performed on the effects of regulatory strategies. Particular emphasis should be placed on the issuance scale of digital currencies and their hierarchical adjustments within the monetary system to grasp the evolution direction of financial asset allocation in real-time [8]. Examining the impact of digital currencies on monetary demand theory and exploring the dynamic balance between transaction, reserve, and speculative motives can help more accurately predict the demand for currency issuance. Simultaneously, attention should be paid to the circulation speed of digital currencies. By precisely tracking the timing and speed of each transaction and applying the weighted average method, the average circulation speed of legal digital currencies can be intuitively analyzed, thereby inferring trends in money supply changes. This is crucial for precise control of currency issuance volume and frequency. Furthermore, monitoring the money multiplier is equally important. Utilizing big data technology to enhance the measurement accuracy of legal digital currencies cannot be overlooked in strengthening the role of the money multiplier. Additionally, through model building and comparative analysis of the intermediary targets and intervention means of digital currency monetary policy, a comparative study can be conducted between aggregate control tools and price control tools.

2.6. Safety and security

With the increasing prosperity of the internet economy, the frequency of online transaction activities has

made traditional paper currencies no longer fully adapted to the needs of the times. The expansion of the virtual economy has increasingly highlighted its shortcomings. The emergence of legal digital currencies has injected new vitality into currency's role in serving the economy and society. It enables central banks to more precisely grasp macroeconomic dynamics, especially the actual operational situation of the virtual economy. Deep analysis of the application of digital currencies in the virtual world can achieve comprehensive coverage of currency functions in the field of transactions. With the popularization of legal digital currencies, they will gradually replace other digital currencies in the virtual economy. Backed by national credit, they strengthen the authority and trustworthiness of currency issuance, ensuring the stable operation of the financial and economic systems.

2.7. Impact on traditional finance and currency

Since the official circulation of legal digital currencies, the currency structure has entered a stage of transformation. Transitioning from traditional currency forms to digital currency forms will undergo a conversion process, and it is expected that digital currencies and paper currencies will coexist for a considerable period. Under the framework of the integration of digital currencies and traditional currencies, big data analysis needs to conduct in-depth research on the interaction paths, influence logic, and mechanisms of the two, focusing on exploring the potential impact of digital currencies on the total currency supply, demand, circulation rate, money multiplier effect, and the stability of the financial system, to support the smooth transition of the currency system. Additionally, digital currencies will also have a significant impact on the operational efficiency and security of financial infrastructure such as payment and settlement. Big data analysis also needs to focus on monitoring and managing the characteristics of digital currencies in core areas such as payment, clearing, and credit systems.

3. Analysis of the application of big data in blockchain finance

3.1. Building a new financial credit system

In the lending business, whether for individuals or enterprises, financial institutions generally rely on the credit reporting system of the central bank. Banks need to upload customer information to this system and, with customer consent, download the required credit data from the central bank system. This process is time-consuming, inefficient, and difficult to ensure accuracy, leading to increased costs. By applying blockchain and big data technology, a large amount of data can be automatically recorded and stored in various nodes of the blockchain network. These nodes are located everywhere, and each computer can achieve information sharing. To modify the data of a node, support from more than 51% of the nodes is required, making it difficult to tamper with the information on the node. Information is stored in an encrypted manner in a decentralized system, so banks do not need to apply for credit reports from the central bank when approving loans. They can simply extract relevant information from the blockchain to complete the credit reporting process [10].

3.2. Constructing a new model of big data finance

In today's society, people generate massive amounts of information and data in their daily lives. After careful processing and screening, some high-quality data are retained, which play a crucial role in areas such as business operations and loan approvals. Especially in the financial sector, such data is widely used in risk assessment, credit issuance, insurance business, asset allocation, and other links. For example, credit scoring

is an indicator that measures the default risk of an organization or individual. A lower score indicates a higher possibility of default. Usually, when evaluating an organization's credit, banks mainly rely on indicators such as financial statements and company strength. However, this evaluation method has certain limitations because it is relatively simple and not comprehensive. Considering that large enterprises have extremely large financial report data and complex transaction records with partners, manual analysis is not only time-consuming but also inefficient. If big data analysis technology is combined with artificial intelligence and machine learning algorithms to deeply mine these data, it will help more accurately evaluate the operating status and default risk of enterprises, while combining with manual field investigations for comprehensive judgment. For example, when assessing users' credit ratings, banks will evaluate users' borrowing risks based on different credit ratings.

3.3. Building a peer-to-peer new financial transaction system

The core of blockchain technology lies in decentralization, which enables peer-to-peer transactions to be realized on the blockchain platform. Using blockchain as a technical support, a new generation of financial transaction platforms can be built, which exhibit lower costs and higher efficiency in the transaction process. Simultaneously, the peer-to-peer transaction model also enhances transaction security and complies with regulatory requirements. For example, the points system launched by many financial institutions is different from traditional points systems. In traditional systems, users can only use the points they have accumulated themselves. However, in the blockchain points system, users can gift their extra points to others by sending red packets. Additionally, some partners have also launched blockchain-based products that users can use to redeem points, enabling customers to truly control their data and information.

4. Conclusion

At this stage, many organizations are still in the early stages of technological progress, and due to a lack of practical experience, they must continue to experiment and explore. With the introduction and application of big data by numerous companies, data security and protective measures are showing inconsistencies. In the current wave of economic and data globalization, this trend has become irreversible. Giant enterprises or network companies that possess large amounts of data will have a profound impact on the global market's credit system through their actions. Therefore, there is an urgent need to utilize blockchain technology to encrypt private assets and ensure their security. As the amount of blockchain data grows, traditional roles in the financial sector are being weakened, which is expected to revolutionize the technical systems we currently rely on.

Disclosure statement

The author declares no conflict of interest.

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