Design of Microgrid System Based on Block Chain

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Abstract

Block chain technology is developing rapidly. It is the most potential Internet distributed technology. Virtual encrypted digital currency is based on block chain technology. Bitcoin and other encrypted currencies have caused major changes in the digital currency field. The application scenario of block chain technology slowly extends from the original financial field to all walks of life[1] .The micro-grid is an important part of the power grid, which aims to realize the flexible and efficient application of distributed power supply and solve the problem of large number and diverse forms of distributed power supply connection.In this paper, the design and implementation of the microgrid system based on block chain are studied. In this system, the transaction mode and the trading platform system of the microgrid based on block chain are proposed.

Keywords

Block chain micro-grid smart contract electricity transaction.

1. Introduction

The block chain technology is currently in the early stages of development and is tried to be applied in various scenarios. The core of the block chain application is the interactive transaction mode embodied in the de-center, solving the trust problems between the nodes in the distributed and decentralized systems. At present, the block chain technology has achieved great success in the application of virtual digital currency, and in other application scenarios, because the block chain technology is contrary to the centralized structure, Block chain technology replacing the centralized structure in each application scenario is the main way for block chain technology to land, and block chain technology currently has disadvantages such as low efficiency and heavy functions, resulting in many scenarios in the application of block chain technology. Exploration phase, However, with the development of technology and the improvement of the efficiency of smart devices, issues such as low efficiency and heavy functions will be solved.

As an important part of a strong smart grid, microgrids can efficiently integrate all kinds of distributed energy, increase the permeability of renewable energy, and compensate for the defects in the concentration of power supply in large grids. Can be used as a powerful part of the grid . Microgrids have multiple advantages, such as distributed clean energy in situ digestion, flexible power access and disconnection, the stability of the microgrid as a whole, and the ability to independently operate the power supply in the event of a failure of the upper grid. If the infrastructure of the large grid does not provide power to the city in the event of natural disasters or failure, the solar panels or distributed photovoltaic power stations in the neighbors 'homes can serve street residents. At present, the micro-grid open power trading platform needs to be established. China's development of micro-power grids is relatively late compared to developed countries such as Europe and the United States. However, the Chinese government attaches great importance to it. Under the impetus of the "Twelfth Five-Year Plan", it has continuously issued construction and guidance documents, and micro-power grid technology has developed rapidly. Pilot projects have mushroomed. One after another, each has its

own characteristics. As a new technology which has attracted much attention in recent years, block chain technology has provided new ideas and methods for the microgrid system architecture.

2. Trading patterns of microgrids

The difference between the microgrid trading model and the traditional trading model is that users in the microgrid model can not only purchase electricity and electricity in the consumer mode, but also sell electricity as energy owners. Users can use, sell or store their excess electrical and chemical energy. This provides users with great convenience when buying and selling energy.

There are many similarities between block chain technology and microgrids. First, both emphasize the characteristics of decentralization. The decentralized application in microgrids embodies the connection between producers and consumers. The application of this distributed relationship in the direction of the Internet is most suitable for block chain technology. Secondly, the intelligent contract of the block chain can guarantee the autonomy and self-discipline of the micro-grid, which is embodied in the intelligent scheduling and intelligent decision-making of the micro-grid.

2.1 Microgrid Trading Platform System

As shown in Figure 1, the block chain platform is divided into three parts: the trading platform Web application, the trading container, and the bottom of the trading platform. 3] The Web application section is responsible for user management and account management and other block chain business management modules and user interaction modules. Block chain trading containers are responsible for the implementation of transaction modes such as consensus algorithms and smart contracts. The bottom of the trading platform is responsible for controlling the scheduling module and the trading platform terminal.

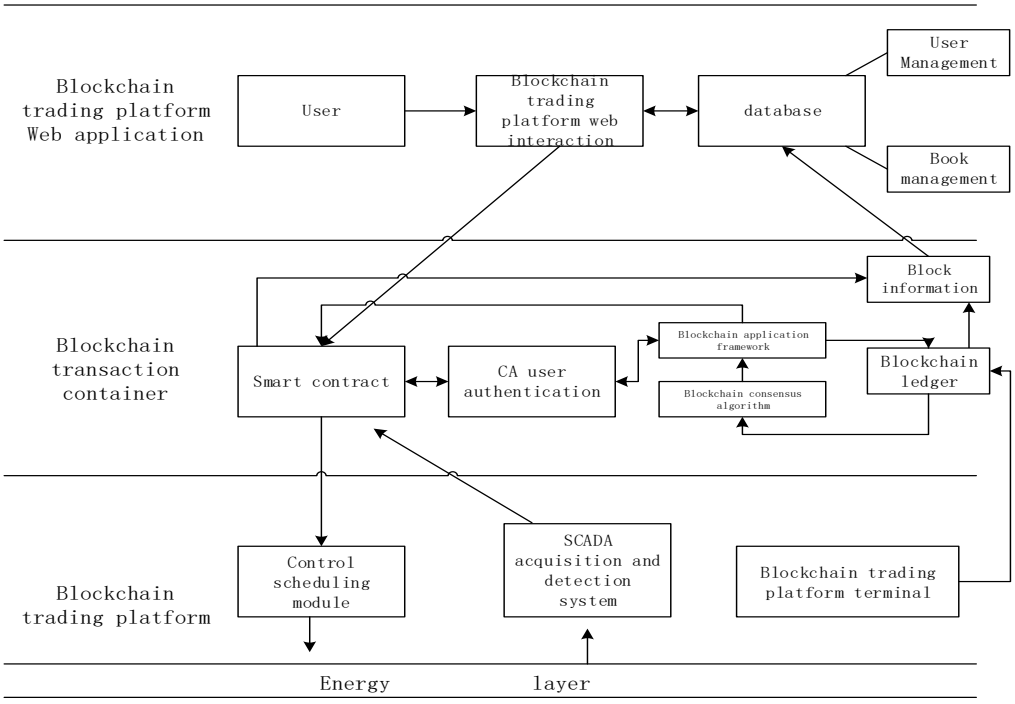

Figure 1 blockchain trading platform system

2.1.1 The bottom layer of the blockchain trading platform

The traditional blockchain model relies on Internet technology for peer-to-peer Internet transactions, and implements blockchain applications in the form of mining. Blockchain technology applied to the information layer must be coupled with the energy layer by means of hardware devices. The basic platform of blockchain trading should include monitoring system SCADA, data acquisition system, control and scheduling system and scalable operating system platform. SCADA is responsible for information collection and information flow, and coupled with blockchain technology to ensure the

output of the information layer to the energy flow, and finally the transaction behavior between the physical layer and the blockchain.

2.1.2 Blockchain transaction container

The smallest unit in a blockchain is called a node. The entity of a single node can be a person, an organization, an organization, a computer, a cluster, and so on. In the energy blockchain architecture, one node is mapped to a device capable of blockchain transaction behavior. The trading platform blockchain module first includes the basic three layers of data in the blockchain six-layer model. Layer, network layer, consensus layer. This three-tier infrastructure ensures the basic implementation of the blockchain technology for the trading platform. The smart contract at the contract level sets the trading mode and trading behavior of the blockchain, and also includes the control mode and control behavior. The blockchain transaction is carried out in the container. The container provides a virtual sandbox to ensure the security of the trading environment. It provides isolation with isolation and provides agile solutions for the deployment of blockchain trading nodes.

2.1.3 Blockchain trading platform web application

The blockchain trading platform Web application includes the application layer and the incentive layer. The incentive layer is mainly used in the public chain at present. The incentive layer digitizes the assets and stimulates users and nodes in the form of tokens or points. The application layer is the top structure of the blockchain. The user can implement the blockchain transaction behavior through the application layer, and the application module includes user management, user transactions, transaction inquiry, transaction pending order and other webpage transactions.

2.2 Energy Trading System Architecture

The energy trading system architecture is shown in Figure 2. The energy trading system consists of a transaction layer, an expansion layer and a blockchain layer. The blockchain layer is the underlying foundation of the architecture, and the transaction layer completes the energy transaction between multiple systems with the technical support of the extension layer.

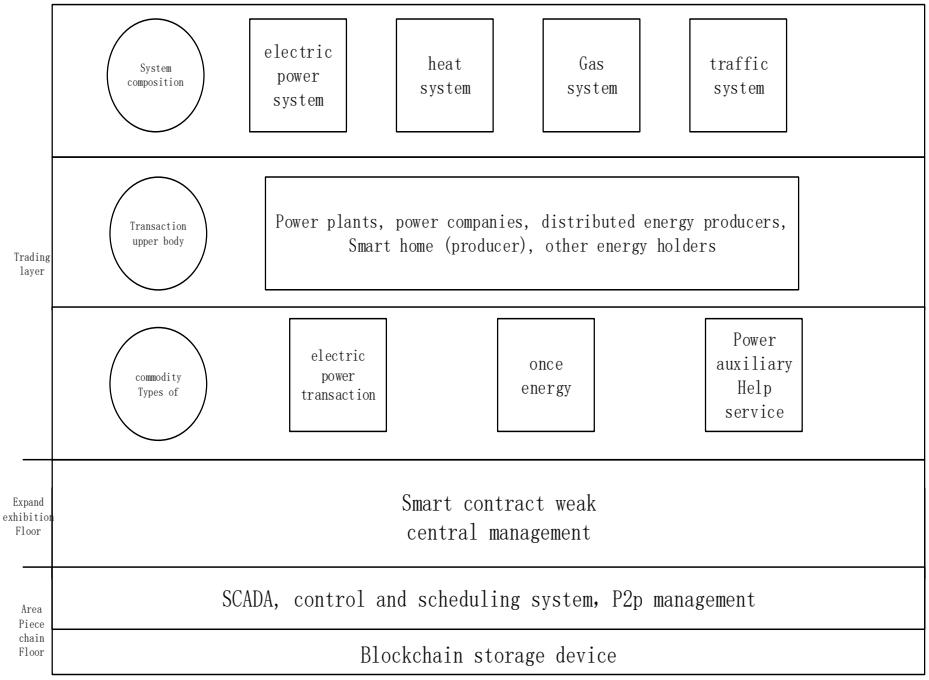

Figure 2 Energy trading system architecture

The thermal system, power system, and gas system transportation system constitute the trading layer of the energy trading system. The trading entities mainly include power companies, smart homes, power plants, distributed energy producers and other energy holders. The role of the trading layer is to initiate and complete energy transactions, then send the data to the data layer to form a smart

contract, and then send the transaction data formed through weak centralization management to the blockchain layer.

The expansion layer mainly consists of two components: smart contract and weak centralization management. The transaction entity negotiates to reach the transaction intention and form a smart contract, and the contract is broadcasted to each node of the blockchain through the peer-to-peer network. When the execution conditions of the contract are met, the contract is automatically executed to improve the transaction efficiency. At the same time, energy is different from ordinary commodities. It is inseparable from the necessary management during the transaction. For example, in order to ensure the safe operation of the power grid, some global information must be mastered by the central organization and judged, and the power transaction should be coordinated; It is difficult to completely solve the problem only by the enforcement of the system itself and the smart contract; relevant trading standards and equipment safety standards need to be formulated by the regulator.

Smart contracts and weak centralization management are the main components of the expansion layer. The transaction entity negotiates to reach a trading intention and forms a smart contract, and the peer-to-peer network propagates the contract to each node of the blockchain. The contract is automatically executed when the condition is met, which increases the efficiency of the transaction. At the same time, in order to ensure the security of the operation of the power grid, management is carried out during the transaction, and some global information is mastered and judged by the central organization, and the power transaction is coordinated.

The blockchain layer is the underlying technical foundation of the transaction architecture, consisting of P2P networks and SCADA, control and scheduling systems, and storage devices. The blockchain layer has a large number of network nodes, each node is a storage point of the blockchain, has its own storage device, and the nodes are all equal and connected and interact with each other in a flat topology to form a P2P network. Each node undertakes network routing, verifies and propagates block data, stores data records, discovers new nodes, and so on, and nodes can decide to join or exit the network according to their own conditions.

During the transaction, participants automatically generate smart contracts after a bilateral or multilateral transaction is reached through the game. Smart contracts should have attributes such as the identity of the parties to the transaction, energy quota, price, trading time, and amount of default. At the same time, the parties to the transaction use the private key to sign to ensure the validity of the contract. After the conclusion of the transaction intelligence contract is completed, it will be announced to the blockchain network, and the node will package the transaction intelligence contract received within a certain period of time into a block and continue to broadcast to the whole network. Finally, all nodes compete for the accounting rights and obtain the accounting. The node of the right is responsible for putting the block into the blockchain storage and continuing to accept subsequent blocks. In this process, the weak centralization organization checks each transaction and is always ready to terminate the illegal transaction.

3. Issues and challenges

At present, our country has less research on the energy Internet, distributed energy needs distributed power auxiliary service, and distributed energy will have a certain impact on the power grid. The research on distributed power auxiliary service is less, and it lacks certain practicality and theory. Once the energy transaction based on block chains is applied to the market, it will greatly increase the complexity of scheduling. A large number of energy transactions have put forward higher requirements for the transmission capacity and pressure resistance of trading systems and stability.

4. Conclusion

The characteristics of block chain development, autonomy, decentralization, and tampering can provide a good basis for the development of energy Internet. The smart contract of block chain

technology guarantees the security and credibility of point-to-point trade in energy. The emergence of block chains has made the development of energy Internet safe and legitimate.

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