

Study on Token-based Access Control Model for Smart Factory using Blockchain with Digital Twins

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Abstract

Digital twins in smart factories can predict accurate results by simulating product design and processes in a virtual environment. When operating a smart factory, confidential documents such as enterprise processes/design plans are applied to digital twin environments, and access control is also required. Existing access control relies on authentication through biometric recognition and card keys, which has led to persistent privacy and security issues such as the leakage of personal information. In this paper, we propose a token-based access control model that prevents data modulation and inappropriate access attempts by using tokens generated based on blockchain when accessing digital twin environments to check access management and records during access. The tokens required for access are configured on a blockchain basis to ensure that access rights and management to digital environments where confidential documents are stored and utilized are performed accurately.

Keyword : Digital Twin, Smart Factory, Blockchain-based token, Token, Access

1 Introduction

Smart Factory, a facet of Industry 4.0, revolutionizes manufacturing by employing digital automation methods to gather and analyze real-time process data, spanning design, development, manufacturing, and logistics. Through digital twins—virtual replicas of physical data—operations become predictive and adaptable, allowing real-time monitoring and issue resolution. This integration of smart manufacturing within digital twins is a pivotal step toward Industry 4.0's goals. [1]. Currently, confidential information leakage is an important issue in many industries. Industrial damage caused by confidential leaks, spying activities, and even hacking using personal information. Research on access control using blockchain tokens[2] and smart contracts[3] is underway. There is still insufficient research on access control tokens in the digital twin environment in the smart factory. If blockchain-based token generation and confidential information protection research through smart contracts are actively conducted within the smart factory, the achievement of Industry 4.0 goals and confidential information protection will be further strengthened.

2 Methods

In the proposed model, blockchain is introduced in the token generation method used to verify access rights to ensure the integrity of the token in which the authentication process takes place, increase practicality by issuing automated tokens under smart contract terms when generating tokens, and strengthen security for confidential documents. To describe in detail the proposed model first, when accessing the digital twin external process, users provide personal information and confirm access rights

based on the provided personal information. Access to the digital twin environment is possible through this step. Next, tokens are created based on personal information provided when accessing external process for users. The authentication token has integrity and invariance based on the blockchain to prevent forgery, change of the tokens, and ensure reliability through a procedure that is automatically generated after confirming the satisfaction of the conditions using a smart contract. Smart contracts allow the user to check the role of the user who requested data access and confirm he is an administrator for the requested data to lead to the token generation process. Finally, users can check permissions through smart contracts, access through blockchain-based tokens, verify permissions, and receive data through DB. Blockchain-based tokens are used to ensure access according to authority through an authority verification process.

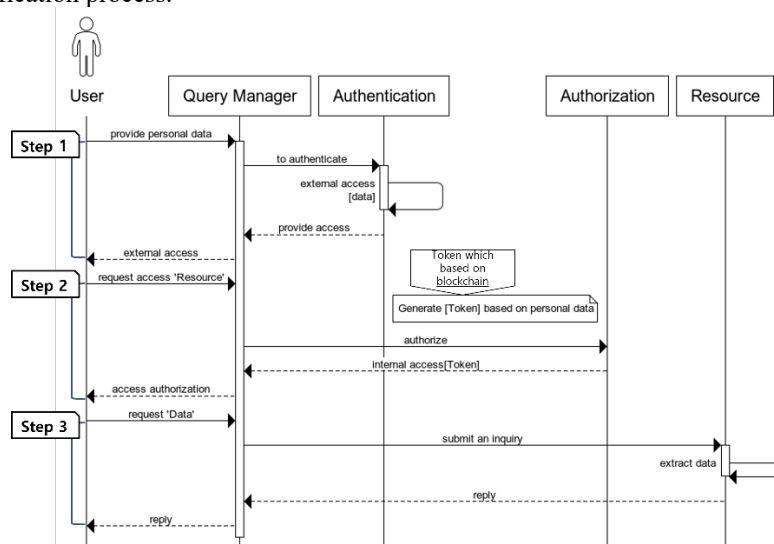


Figure 1: Proposed token-based access control model

Blockchain-based token application ensures integrity and immutability of tokens used in user authentication. It is possible to solve a problem that could have caused forgery or change of tokens by stealing other user's information. In the smart factory environment using digital twins with the proposed model, it is expected to prevent leakage accidents that may occur when accessing technical confidential documents in use in the environment. In terms of security, it is possible to protect intellectual property, manage internal risks, and provide safety and sustainability to the industry to prevent leakage.

3 Conclusion

By creating tokens based on blockchain and managing access records, it is easy to check and manage records, and it can be expected to prevent information leakage problems that occur when creating and using tokens. In addition, research is needed to establish smart contract conditions used in the process of generating blockchain-based tokens and to ensure that access control is carried out normally.

References

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