

Can the blockchain-enabled interplanetary file system (Block-IPFS) be a solution for securely transferring imaging data for artificial intelligence research in oral and maxillofacial radiology?

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Dear Editors,

With the increasing need for radiographic data to be used in artificial intelligence (AI) studies, privacy, security, and ethical considerations regarding the storage and sharing of imaging data have emerged as a new topic of discussion. At the international level, there is currently an appreciable focus on the ethics of AI.¹⁻³ Data privacy includes safe storage, the reduction of risks during the process of data sharing, and suitable erasure. All data sharing methods between medical experts and AI developer teams have spontaneous security risks, including misuse and misinterpretation of data.¹⁻³ Innovative solutions are needed for the storage, transfer, and reliable processing of data to solve these problems and end these discussions. This letter aimed to raise attention to the possibility that the blockchain-enabled interplanetary file system (Block-IPFS) (Fig. 1) could be a solution for securely transferring imaging data for AI research in oral and maxillofacial radiology.

Blockchain technology is well-known to have started with the advent of the electronic currency named Bitcoin.⁴ The basis of blockchain technology comprises a distributed, decentralized ledger database. Data in a distinctive format are systematized into blocks in a particular way depending on cryptography and peer-to-peer (P2P) networking. The systematized data in the blocks are constructed into a data chain complex in chronological order. Each block in the chain includes a series of transactions. Although the term “transaction” is used in the context of financial transactions

or exchanges of money, it would also be possible for transactions to involve medical records and images or applications. Cryptographic proof is used to confirm records in a blockchain system. This cryptographic confirmation is performed by a blockchain network of users who jointly adhere to a pre-agreed set of rules. In this way, only a single correct form of all occurrences is saved in the database. It cannot be modified later without the approval of most of the nodes. Each block locks the previous block using a hash algorithm. When there is a change in a block, the hashes of all following blocks are changed.⁴⁻⁸

Blockchain technologies have the capability of decentralized and secure data access. The integrity and inalterability of the data are ensured by cryptography and reconciliation mechanisms.⁴⁻⁸ At present, blockchain technology can be used in different domains - including, but not limited to, the interplanetary file system (IPFS), cloud, internet of things (IoT), information security, and healthcare - due to its extraordinary characteristics. IPFS is a P2P decentralized, distributed file system for flexibly storing and sharing data to link overall computing tools with a uniform system of files forming a generalized Merkle distributed acyclic graph (DAG), unlike a traditional central server. The DAG connects objects using their hash. IPFS allows users not only to take content, but also to accommodate it. Users on the IPFS network can deliver data using content addresses. Others on the IPFS network can find and request this content from any node that controls it using a distributed hash table. To solve problems related to storage and the preparation of restrictions for nodes, IPFS has an altered P2P architecture with a distributed ledger design. Blockchains have a protocol-specific DAG structure that links past

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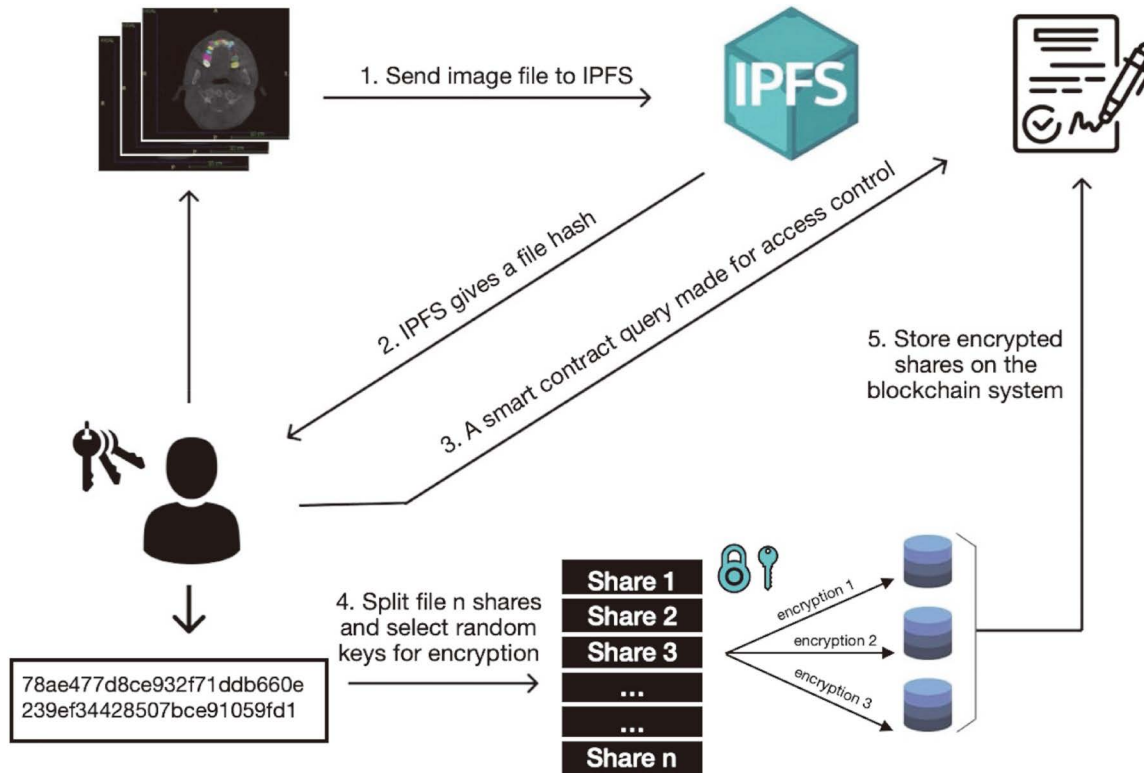


Fig. 1. A diagram of blockchain-enabled interplanetary file system (Block-IPFS) proposed for secure radiographic image transfer (diagram adapted from the study of Naz et al.⁹).

blocks to earlier hash rates. The combination of IPFS and blockchain enables doctors to save network bandwidth on the blockchain by eliminating the need to put the data itself on the chain.⁹⁻¹⁴ Various distributed file systems (DFSs) have been created for ease of data entry and storage, instead of for the protection of authorship. These natural features of DFSs have made it challenging to create a simplified and easier-to-maintain data structure. Moreover, there is also currently no functionality that prevents a legitimate user from sharing hashes with others outside the network (e.g., through email). Only state entries (or changes between 2 blocks) need to be stored using the IPFS-based blockchain.⁹⁻¹⁴

In conclusion, data privacy, storage, and secure sharing will become even more important in the coming years with the increase in the number of AI studies. Oral and maxillofacial radiologists, radiology technologists, and computer scientists should be aware of these issues to generate suggestions for possible solutions. Block-IPFS may be a promising technology for solving these problems securely and easily.

Conflicts of Interest: None

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