Blockchain-Based Decentralized Architecture for Secure Medical Records Management

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Abstract : This research integrated blockchain technology to reform medical records management in healthcare informatics. It was aimed at resolving the limitations of centralized systems by establishing a secure, decentralized, and user-centric platform. The system was architected with a sophisticated three-tiered structure, integrating advanced cryptographic methodologies, consensus algorithms, and the Fast Healthcare Interoperability Resources (HL7 FHIR) standard to ensure data security, transaction validity, and semantic interoperability. The research has profound implications for healthcare delivery, patient care, legal compliance, operational efficiency, and academic advancements in blockchain technology and healthcare IT sectors. The methodology adapted in this research comprises of Preliminary Feasibility Study, Literature Review, Design and Development, Cryptographic Algorithm Integration, Modeling the data and testing the system. The research employed a permissioned blockchain with a Practical Byzantine Fault Tolerance (PBFT) consensus algorithm and Ethereum-based smart contracts. It integrated advanced cryptographic algorithms, role-based access control, multi-factor authentication, and RESTful APIs to ensure security, regulate access, authenticate user identities, and facilitate seamless data exchange between the blockchain and legacy healthcare systems. The research contributed to the development of a secure, interoperable, and decentralized system for managing medical records, addressing the limitations of the centralized systems that were in place. Future work will delve into optimizing the system further, exploring additional blockchain use cases in healthcare, and expanding the adoption of the system globally, contributing to the evolution of global healthcare practices and policies.

Keywords : healthcare informatics, blockchain, medical records management, decentralized architecture, data security, cryptographic algorithms

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