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OASIS OF KNOWLEDGE

SCHOOL OF INFORMATICS AND INNOVATIVE SYSTEMS

DEPARTMENT OF COMPUTER SECURITY AND SOFTWARE ENGINEERING

TITLE: Decentralized Healthcare Data Management System

(DH-DMS) Using Blockchain and IPFS

CONCEPT PAPER BY:

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INTRODUCTION

The entire process of managing sensitive patient data is very critical in the health industry because it somehow affects the quality and timeliness of medical services offered to the patients. The currently existing centralized health systems, although functional, can be very open to attacks such as data breaches and unauthorized access to medical records. Additionally, they do not provide patient-centric control and are not able to scale efficiently to meet the increased amount of data. This project introduces a Decentralized Healthcare Data Management System (DH-DMS) based on the use of Blockchain and InterPlanetary File System (IPFS) technologies. The approach uses Blockchain for access control security and IPFS for scalable data storage. The proposed solution increases data security, privacy, and usability while complying with healthcare regulations, such as HIPAA and GDPR.

BACKGROUND INFORMATION

The healthcare sector has seen rapid digital transformation, leading to an increase in use of electronic health records (EHRs), diagnostic images, and even more sensitive data. However, Centralized storage systems that were earlier in use or currently in use have become easy targets for breaches that have translated into financial losses and mistrust between patients and doctors. Blockchain has shown immutable and tamper-proof data management, while the decentralized storage could be facilitated with IPFS, thus making them the best candidates for securing healthcare data.

Estonia's e-health system demonstrates the potential of blockchain technology for securing healthcare records through decentralized and tamper-proof solutions (Mandarino et al., 2024). However, joining Blockchain and IPFS to solve the problems concerning scalability and interoperability has not yet been explored thoroughly. Therefore, this project aims to combine these technologies into an entire system of patient-managed health data.

PROBLEM STATEMENT

With the rapid growth in electronically stored medical information, the demand for robust security measures has never been greater. Centralized systems that house sensitive patient data, such as medical records, diagnostic images, and treatment plans, expose these assets to significant risks, including unauthorized access and breaches.

The inability to access critical patient records at the right time can have devastating consequences, such as delays in treatment and compromised healthcare outcomes. These vulnerabilities not only jeopardize patient lives but also erode trust in healthcare systems.

To address these pressing challenges, this project proposes a transformative solution by leveraging Blockchain and IPFS technologies. This approach aims to redefine data security and accessibility in healthcare, ensuring both scalability and patient autonomy while enhancing overall system reliability.

OBJECTIVES

Main Objective

- To create a secure, scalable, and patient-managed healthcare data management system that leverages Blockchain and IPFS technologies.

Specific Objective

1. To design and implement a Blockchain-based access control mechanism for medical records.
2. To use IPFS for decentralized and cost-effective storage of encrypted patient information.
3. To ensure compliance with data privacy regulations such as HIPAA and GDPR.
4. To address scalability issues using off-chain data storage techniques.
5. To evaluate the system's performance in terms of security, cost, and user experience.

RESEARCH QUESTIONS

1. How can Blockchain and IPFS be effectively integrated for healthcare data management?
2. What mechanisms can be implemented to ensure patient-controlled access to medical records
3. What features of the system add to compliance with the data privacy regulations?
4. According to decentralized healthcare systems, what are the benefits of scalability in comparison to centralized systems?
5. What are the proposed systems for mitigating the risks associated with breaches of data?

SIGNIFICANCE OF STUDY

The project aims to decentralize data management in health care, focusing on very critical issues. Its outcomes include:

- Greater security by reducing the risks of breaches and unauthorized access through decentralized structures.
- Patient empowerment, allowing patients more control over their medical information, fostering trust and transparency.
- Cost efficiency through a reduction in the operational costs involved in centralized storage.
- Regulatory compliance for health service providers with data privacy legislation.
- Future Advancements: The system's decentralized nature offers a foundation for integration with emerging technologies, such as Artificial Intelligence (AI), to improve data analytics, predictive modeling, and personalized medicine. It can also support Internet of Medical Things (IoMT) devices by securely managing data exchange in real-time

This project adds to the progressive change from traditional to digital systems in health care and provides space for secure and patient-centered data management.

DEFINITION OF TERMS

- Blockchain: It is a decentralized technology ledger, which makes sure that the data entered in it is immutable and safe.
- IPFS: A peer-to-peer protocol adopted for decentralized file storage and sharing.
- HIPAA: Health Insurance Portability and Accountability Act; The U.S. law on the protection of sensitive health information.
- GDPR: General Data Protection Regulation; Data protection and privacy regulation of the European Union.
- Smart Contracts: Self-executing contracts with rules and conditions embedded on a blockchain.

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