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BLOCKCHAIN BASED ELECTRONIC MEDICAL RECORD SYSTEM (EMR)

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ABSTRACT

A blockchain is a type of distributed ledger that maintains an ordered list of records called blocks. These blocks are connected through cryptography and contain a hash of the previous block, timestamp, and transaction data.An Electronic Medical Record (EMR) is a digital tool used to track and manage patient health information. It allows healthcare organizations to store and share patient records electronically. This paper addresses the challenges of securely sharing electronic medical records across different healthcare organizations. It proposes a blockchain-based solution that decentralizes patient data into a single record held by the patient, ensuring secure storage, access control, and efficient transfer of medical records. The proposed system utilizes blockchain technology to protect patient privacy and security, utilizing cryptographic hash and smart contracts to ensure that data is kept confidential and secure.The goal of this proposed system is to increase efficiency, credibility, and reduce barriers in the healthcare sector while promoting greater transparency and control of sensitive data.

Keywords; Blockchain Electronic Medical Records, Decentralized, Cryptographic hash, Smart contract.

INTRODUCTION

An innovative solution for storing and sharing medical records is a blockchain-based Electronic Medical Record (EMR) system. An EMR is a digital version of a patient's paper chart that contains all medical information such as diagnoses, medication history, treatment plans, and test results. Traditionally, EMRs are stored in centralized databases owned and controlled by healthcare providers, which raises concerns about data privacy, security, and interoperability.

To address these challenges, blockchain technology provides a decentralized, immutable, and transparent platform for storing and sharing medical records. A blockchain is a distributed ledger that securely records all transactions. Each block in the chain contains a cryptographic hash of the previous block, creating a tamper-proof record of all transactions. A blockchain-based EMR system empowers patients to take control of their medical records and share them with healthcare providers on a need-to-know basis. Providers can access patient records in real-time to make informed decisions about care. Additionally, the system can enhance data privacy and security by encrypting patient data and giving patients control over who can access their records.

RELATED WORK

The blockchain-based Electronic Medical Record (EMR) system is an emerging research field that aims to utilize blockchain technology to provide a secure, decentralized, and immutable platform for managing patient medical records. Many related studies demonstrate the potential of blockchain technology to transform the way healthcare providers manage patient data and deliver care. However, additional research is necessary to address the scalability, interoperability, and regulatory challenges that arise with blockchain-based EMR systems.

LITERATURE REVIEW

To conduct this project, a survey was conducted by reviewing recent research papers and books related to the topic. The methodology used in one of these papers is discussed in reference[5].

M. A. Uddin, A.et.al presents a remote patient monitoring (RPM) architecture that utilizes a patient agent (PA) to select miners based on their available CPU resources and previous performance. By doing this, the time required for monitoring is minimized. However, the article does not discuss the smart contract mechanism or consensus mechanism used in this architecture. It is important to note that this architecture is vulnerable to denial-of-service attacks and ransom cyber-attacks.

J. Chen, X. Ma. et.al proposes a new business process for medical information sharing using a blockchain mechanism that is "patient-centric," meaning the patient has full authority over viewing and sharing their medical records. However, the authors do not analyze the smart contract mechanism under the permissioned blockchain used in this approach.

G. Yang and C. Li proposes a blockchain-based architecture for electronic health record (EHR) systems that includes a new incentive mechanism for creating new blocks in a blockchain-based system. The proposed architecture utilizes a smart contract mechanism to facilitate agreements between patients and providers. It is important to note that the proposed architecture follows a "provider-centric" approach.

K. N. Griggs et.al discusses a blockchain-based smart contract for secure remote patient monitoring. The proposed method uses smart contracts and the Practical Byzantine Fault Tolerance (PBFT) consensus mechanism. However, the author does not discuss key management and authentication, as well as the vulnerability of blockchain-based specific attacks such as the 51% attack. S. P. Novikov et.al proposes a decentralized blockchain-based infrastructure for storing electronic medical records (EMRs) of patients in a healthcare system. The proposed scheme follows a patient-centric model and employs smart contracts for accessing patient data. However, the author does not discuss the consensus mechanism and vulnerabilities related to blockchain technology.

X. Liang et.al presents a solution for health data sharing using a private blockchain. The proposed approach is patient-centric. However, the authors do not delve into the details of the smart contract and consensus mechanism underlying the solution. A solution for health data sharing using a private blockchain has been discussed The method proposed is a patient-centric approach. The authors do not explore the underlying smart contract and consensus mechanism.

The proposal suggests a healthcare data management system based on permissioned blockchain technology that prioritizes patient-centric approach for ensuring privacy and security of healthcare data. Smart contracts are employed for interaction with the blockchain, assuming that the user possesses a key and password, but the method for generating these keys is not discussed.The proposed solution for handling electronic medical record systems is a decentralized record management system called MedRec, which utilizes blockchain technology and smart contracts. However, there are concerns regarding the security of individual databases in this architecture.

PROPOSED SYSTEM

The main goal of a blockchain-based electronic medical record (EMR) system is to provide a secure and decentralized platform for managing patient medical records. The system would allow patients to have control over their own records and authorize access to healthcare providers. By leveraging blockchain's secure and tamper-proof nature, the system would prevent unauthorized access and manipulation of medical records, leading

to more efficient and effective patient care through improved data sharing and collaboration among healthcare providers.

METHODOLOGY

The methodology for developing a blockchain-based EMR system can be customized to the specific requirements and goals of the project. However, a general methodology can be followed which includes the following steps:

1. Gather requirements from stakeholders
2. Design the architecture and components of the EMR system
3. Develop the EMR system
4. Test the EMR system for functionality, performance, security, and regulatory compliance
5. Deploy the EMR system to a production environment
6. Maintain and monitor the EMR system for optimal performance and security.

To develop a blockchain-based EMR system, it is necessary to involve stakeholders, such as healthcare providers, patients, regulators, and other relevant parties, to define the scope and requirements of the project. Based on these requirements, the system's architecture and components must be designed. This may involve selecting the appropriate blockchain platform, consensus mechanism, smart contract language, and data storage model. After finalizing the design, the EMR system can be developed by implementing the blockchain infrastructure, developing smart contracts, and integrating with existing healthcare systems and standards. Once developed, the EMR system must be thoroughly tested to ensure that it meets functional, performance, security, and regulatory requirements. After validation, the EMR system can be deployed to a production environment, and it must be maintained and monitored regularly.

Overall, developing a blockchain-based EMR system requires multidisciplinary expertise, including blockchain technology, healthcare domain knowledge, software development, security, and privacy. It also requires close collaboration with stakeholders and adherence to regulatory and ethical standards.

ALGORITHM

The process of implementing a blockchain-based electronic medical record (EMR) system consists of several steps that utilize distributed ledger technology and cryptography to establish a secure, transparent, and tamper-proof method of managing patient health records. Initially, the patient's identity is verified and authenticated to allow access to their medical records. This step can be carried out using different techniques such as biometric identification or secure login processes. After verification, the patient's medical data is encrypted and hashed to protect the privacy and security of the data.

SYSTEM ARCHITECTURE

The system architecture of a blockchain-based electronic medical record (EMR) system typically consists of several layers or components that work together to provide a secure, decentralized, and tamper-proof platform for managing patient data. The following is a high-level overview of the key components of a typical blockchain-based EMR system architecture.

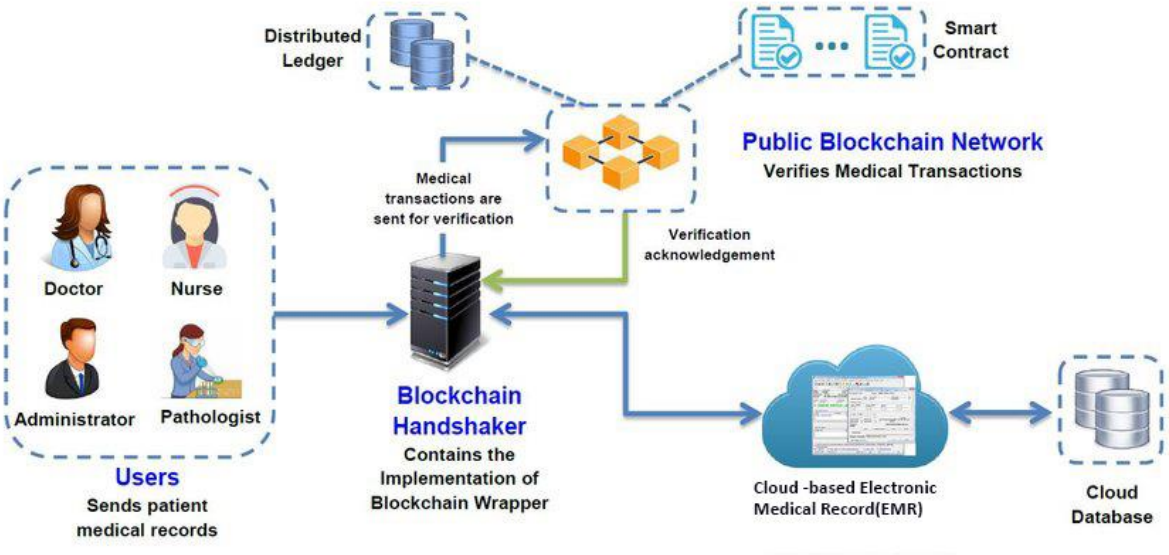


Fig.1 Blockchain based EMR System Architecture

The first layer of the architecture is the blockchain layer, which provides the distributed ledger technology that enables secure and tamper-proof storage of patient data. This layer includes the blockchain network and the consensus mechanism that ensures the validity of transactions and maintains the integrity of the data.

The second layer is the smart contract layer, which provides the logic and rules for the interaction between the blockchain and the various components of the EMR system. Smart contracts are used to enforce access control policies, manage data sharing and consent, and perform other tasks related to the management of patient data.

The third layer is the data layer, which includes the various types of patient data that are stored on the blockchain. This layer may include medical records, lab results, imaging data, and other types of health-related data. The data is typically encrypted and hashed to ensure privacy and security.

The fourth layer is the user interface layer, which provides the interface between the users of the system and the underlying blockchain and smart contract layers. This layer may include various types of user interfaces, such as mobile apps, web portals, and desktop applications, and may be designed for different types of users, such as patients, healthcare providers, and regulators.

Finally, the fifth layer is the integration layer, which provides the mechanisms for integrating the blockchain-based EMR system with existing healthcare systems and standards. This may include interoperability standards, data exchange protocols, and other mechanisms for ensuring that the system can work seamlessly with other healthcare systems and data sources.

EMR SYSTEM MODULES

1. Authentication Module: This is the most common form of authentication, in which users are required to provide a username and password to access a system or application. The password is typically stored in an encrypted format to prevent unauthorized access.
2. Patient Module: This module would allow patients to create and manage their own medical records. Patients would be able to access their records online and share them with authorized healthcare providers.
3. Provider Module: This module would allow healthcare providers to access and update patient records. Providers would have to go through a verification process before being granted access to records.
4. Permission Module: This module would manage access controls for patient records. It would determine who has access to what records and when.
5. Data Management Module: This module would handle the storage and management of medical records on the blockchain. It would ensure that records are secure and tamper-proof.
6. Analytics Module: This module would allow for data analysis of patient records to identify trends and patterns. This information could be used to improve patient care and outcomes.
7. Interoperability Module: This module would enable the system to integrate with other healthcare systems and electronic medical records. It would enable the sharing of patient data between different healthcare providers.

8. Smart Contract Module: This module would enable the creation and execution of smart contracts for the management of patient records.
9. Compliance Module: This module would ensure that the system is compliant with healthcare regulations.

IMPLEMENTATION RESULTS

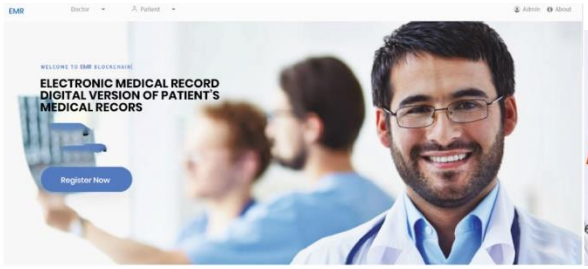


Fig.2 Registration

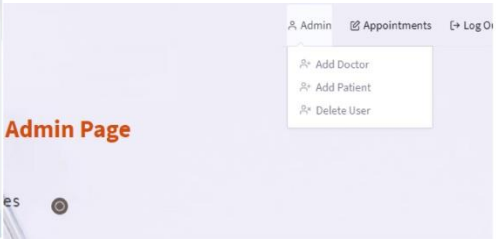


Fig.3 Admin Login

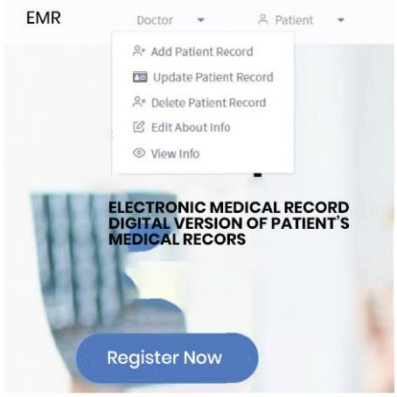


Fig.4 EMR Registration

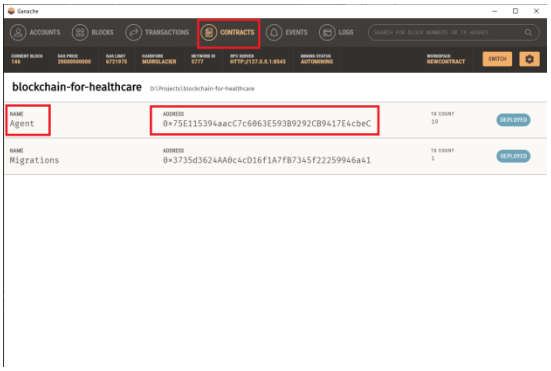
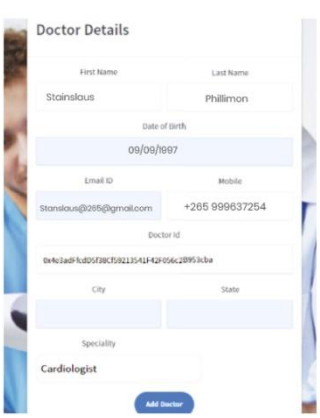


Fig.5 Smart Contract



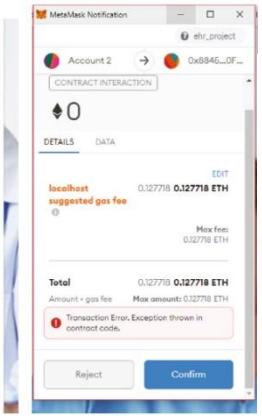


Fig.5 Compliance Module

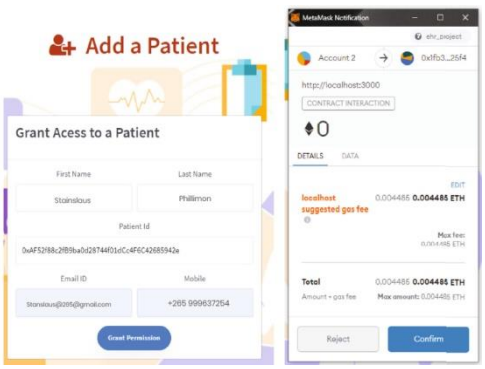


Fig.6 Patient Access

The use of a blockchain-based electronic medical record (EMR) system can lead to improvements in the efficiency and security of the healthcare industry. The system enables seamless sharing of patient information among healthcare providers, while also providing tamper-proof records and enhanced data security through the use of decentralized networks.

CONCLUSION

However, the implementation of a blockchain-based EMR system requires careful consideration of the unique requirements and constraints of the healthcare industry, including regulatory compliance, interoperability with existing systems, and patient privacy. Additionally, the adoption of blockchain technology in healthcare is still in its early stages, and there are challenges to overcome, such as scalability, standardization, and user adoption. Overall, the potential benefits of blockchain-based EMR systems are significant, and continued research and development in this area can lead to improved healthcare outcomes, increased patient empowerment, and reduced healthcare costs.

FUTURE ENHANCEMENT

In addition to real-time data analytics and patient control over their health data, blockchain-based EMR systems could also enable secure sharing of medical research data among different institutions and researchers. This could accelerate medical research and development by providing access to a larger pool of data while ensuring that patient privacy is protected. Overall, the potential benefits of blockchain-based EMR systems are vast, including improved data security, increased efficiency, personalized treatment, patient control over health data, and enhanced medical research. However, the implementation of such systems requires careful consideration of technical, ethical, and legal aspects, as well as collaboration between various stakeholders in the healthcare industry.

REFERENCES

[1] "Blockchain-based electronic medical record system: a review of recent developments" by S. C. Chiu, J. Kuo, and Y. H. Kuo, published in the Journal of Medical Systems in 2018.

[2] "Blockchain-based electronic health record: A new paradigm" by S. K. Kim, Y. J. Lee, and J. H. Kim, published in the Journal of Medical Systems in 2019.

[3] "Designing a blockchain-based electronic health record system: a feasibility study" by L. J. J. van der Meijden, E. F. Verhagen, and M. A. Wieringa, published in the Journal of Medical Internet Research in 2018.

[4] "Blockchain-Based Electronic Health Record Management System" by A. Elhoseny, M. Ali, and M. Yaseen, published in the International Journal of Advanced Computer Science and Applications in 2018.

[5] "Blockchain in Healthcare: Use Cases and Challenges" by P. K. Saha and S. K. Saha, published in the Journal of Medical Systems in 2019.

[6] "Blockchain for Health Data and Its Potential Use in Health IT and Health Care Related Research" by M. J. Kvedar and J. T. Mandl, published in the Journal of the American Medical Informatics Association in 2018.

[7] "Blockchain and Artificial Intelligence in Electronic Health Records Management: A Review" by Y. K. H. Toh and S. K. Loke, published in the Journal of Medical Systems in 2020.

[8] "A Decentralized Blockchain-Based Electronic Medical Record System" by Zhang et al. (2018)

[9] "Blockchain-based secure and efficient data sharing for electronic medical records" by Wang et al. (2019)

[10] "A Blockchain-based Approach to Electronic Health Records and Medical Claims Management" by Sengupta et al. (2019)

[11] "A Blockchain-based Architecture for Secure and Privacy-Preserving Sharing of Medical Records" by Fernández-Alemán et al. (2020)

[12] "Blockchain-based Electronic Health Record System for Secure Healthcare Applications" by Li et al. (2021)