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Data Science

MediTrust - Blockchain Based Healthcare Records Management System

Group No 17

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Project Guide
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Abstract

The **Blockchain-Based Healthcare Records Management** system leverages blockchain technology to securely store, manage, and access patient health records. This decentralized system ensures that medical data is tamper-proof, enhancing trust between patients and healthcare providers. By using cryptographic techniques like **Merkle Trees** and **SHA-256 hashing**, each patient's records are securely stored as blocks on the blockchain, preventing unauthorized access or modifications. The system also ensures data transparency, traceability, and patient control over who accesses their records. This approach aims to address challenges related to data privacy, integrity, and interoperability in the healthcare sector, ultimately improving the overall healthcare experience.

Introduction

- A Blockchain-Based Healthcare Records Management System uses blockchain technology to securely store and manage patient health records.
- This decentralized approach ensures that data is protected, tamper-proof, and easily accessible to authorized providers.
- It addresses issues like fragmented records and data breaches, while enhancing patient privacy by improving data security and availability, it aims to streamline healthcare delivery.
- **Problem Identified :**
- Medical records are fragmented across providers, causing incomplete patient histories and delays in diagnoses.
- Centralized systems are vulnerable to cyberattacks, risking patient data and weakening trust in healthcare.
- **Solution Proposed :**
- Blockchain provides a secure, decentralized way to store healthcare records, ensuring patient data is always available to providers.
- Blockchain's distributed system reduces the risk of data breaches by eliminating a central point of failure, ensuring better data security and privacy for patients.

Motivation:

- The increasing frequency of data breaches in healthcare highlighted the urgent need for a more secure way to protect patient information.
- Seeing patients and providers struggle to access complete health records motivated the need for a solution that improves data access and accuracy.
- Observing the challenges healthcare providers face in accessing complete patient information motivated the search for better solutions.
- The ability of blockchain to improve data security and sharing inspired to explore its use in healthcare.

Objectives

- To implement end-to-end encryption and decentralized storage to guarantee the security and privacy of sensitive patient records, protecting them from unauthorized access or tampering.
- To use blockchain and **Merkle Trees** to create a decentralized, immutable ledger of healthcare records, ensuring that data is not controlled by a single entity, and any changes are transparent and traceable.
- To leverage **SHA-256 hashing** to allow patients to maintain privacy and control over their data by encrypting it, granting access only to authorized individuals or organizations.
- To reduce paperwork and administrative inefficiencies by automating processes such as record updates and insurance claims through smart contracts.

Literature Review

Sr.no	Title	Author(s)	Year	Methodology	Drawback
1	BlockChain for Healthcare Management Systems	Edgar R Dulce Villarreal ,Jose Garcia –Alonso , Enrique Moguel , & Julio Ariel Hurtado Alegria	2023	Conducts a systematic literature review (SLR) on architectural mechanism supporting interoperability & Security in Blockchain based Healthcare Management System	Complexity of Smart Contracts development, security Vulnerabilities, & balancing between interoperability & Security.
2	BlockChain – IOT Healthcare Applications & Trends	Waffa A.N.A A-NBHANY, Ammar Zahary , & Asmaa shargabi	2023	Intersection of IoT, blockchain, and healthcare, analyzing various applications, sensors, hardware, and software used in blockchain-based healthcare systems.	lacks focus on the software languages, databases, tools, and hardware platforms used in Blockchain-IoT healthcare applications.

Literature Review

Sr. no	Title	Author(s)	Year	Methodology	Drawback
3	A Blockchain-Based Electronic Medical Health Records Framework using Smart Contracts	Vardhini B, Shreyas N Dass, Sahana R, Dr. R. Chinnaiyan	2021	The paper proposes using blockchain technology and smart contracts to create a decentralized Electronic Health Record (EHR) system, ensuring secure, immutable, and accessible medical records for stakeholders.	Potential privacy concerns, as it is possible to identify participants in the transactions, and improvements are needed to make medical records more accessible during emergencies.
4	Development of an Internet-of-Healthcare System Using Blockchain	Suparat Yongjoh, Chakchai So-in, Peerapol Kompunt, Paisarn Muneesawang, Roy I. Morien	2021	The paper presents an Internet-of-Healthcare System (IoHCS) that integrates patient data from hospitals using blockchain technology for secure storage and access, supported by MQTT protocol for real-time data retrieval across multiple systems.	The system's reliance on blockchain increases complexity and can introduce challenges in scalability and integration with various hospital information systems

Literature Review

Sr. no	Title	Author(s)	Year	Methodology	Drawback
5	MedAccess: A Scalable Architecture for Blockchain-based Health Record Management	Mohammed Misbhauddin, Abdulaziz AlAbdulatheam, Mohammed Aloufi, Hussien Al-hajji, Ahmad AlGhuwainem	2020	The paper proposes a scalable blockchain architecture using off-chain storage (IPFS) to manage encrypted Electronic Health Records (EHRs), reducing on-chain data storage costs and improving data privacy and accessibility.	Storing large-scale medical records on blockchain remains computationally expensive, and the system requires further cost-reduction strategies for long-term feasibility.
6	BlockHR – A Blockchain-based Healthcare Records Management Framework: Performance Evaluation and Comparison with Client/Server Architecture	Leila Ismail, Huned Materwala, Youssef Sharaf	2020	The study proposes BlockHR, a blockchain-based framework for healthcare record management, and compares its performance with the client-server model, evaluating security, privacy, and execution times for data operations	BlockHR's write operations are slower than the client-server approach due to the consensus mechanism, though it offers significant improvements in data retrieval speed

Literature Review

Sr. no	Title	Author(s)	Year	Methodology	Drawback
7	Attribute-based Multi-Signature and Encryption for EHR Management: A Blockchain-based Solution	Hao Guo, Wanxin Li, Ehsan Meamari, Chien-Chung Shen, Mark Nejad	2020	Proposes a hybrid architecture integrating blockchain and edge nodes, using attribute-based multi-signature (ABMS) and attribute-based encryption (ABE) schemes for secure EHR management.	The system's verification phase is computationally intensive, especially as the number of attributes increases, and the implementation relies on external smart sensors for practical encryption.
8	Smart Contract Designs on Blockchain Applications	Alkhansaa Abuhashim, Chiu C. Tan	2020	The paper evaluates the complexity and efficiency of two smart contract designs (Catalog and Sparse) for indexing and querying blockchain ride-sharing data, using Ethereum testnets and Chicago Divvy Bicycle Sharing data for experiments.	Querying Sparse smart contracts is inefficient and time-consuming, especially when scanning long blockchains, making them less suitable for applications needing frequent data retrieval.

Literature Review

Sr. no	Title	Author(s)	Year	Methodology	Drawback
9	Blockchain-Based Interoperable Electronic Health Record Sharing Framework	Gracie Carter, Hossain Shahriar, Sweta Sneha	2019	The paper proposes a framework using blockchain and cloud computing (AWS and Ethereum) to enable interoperable EHR sharing with multilayer encryption and smart contracts for secure, automated data exchange.	The solution relies on Ethereum, which faces performance issues like scalability and slower transaction speeds, limiting its efficiency for large-scale healthcare data sharing.
10	Research on E-commerce User Information Encryption Technology Based on Merkle Hash Tree	Li Qing	2019	Merkle Hash tree binary structure to optimize the transmission path of information encryption, combining public and private keys for two-way encryption, and verifying the approach through a simulation experiment.	Not explicitly mentioned, but potential limitations include computational complexity, scalability, and security analysis.

Literature Review

Sr.no	Title	Author(s)	Year	Methodology	Drawback
11	Using Blockchain for Electronic Health Records	Ayesha Shahnaz, Dr. Usman Qamar, and Dr. Ayesha Khalid	2019	The authors propose a framework that utilizes Ethereum and InterPlanetary File System (IPFS) to create a decentralized and secure system for electronic health records.	The study does not address the issue of data standardization, and the use of blockchain technology may require significant changes to existing healthcare systems and infrastructure.

Research Gap(Limitations of existing systems)

- **Scalability Issues :** Current blockchain platforms, especially public blockchains, face scalability challenges.
- **Interoperability Between Systems:** Lack of interoperability standards for healthcare blockchain systems makes it difficult to integrate with existing electronic health record (EHR) systems.
- **Cost of Blockchain Implementation:** The high costs associated with implementing and maintaining blockchain infrastructure in healthcare settings can be prohibitive.
- **Data Redundancy and Storage Challenges:** Blockchain's need to store copies of data across multiple nodes can lead to inefficiencies in storage.
- **Data Ownership and Consent Management:** While blockchain gives patients more control over their health data, managing data ownership and consent in a way that is user-friendly and legally binding remains a challenge.

Problem Definition

1. **Data Security :** Existing systems often suffer from vulnerabilities that expose sensitive patient information to unauthorized access.
2. **Patient Control :** Patients have limited ability to control who accesses their data, leading to privacy concerns.
3. **Inefficient Data Sharing :** Manual processes for data sharing can be slow and error-prone, hindering timely patient care.
4. **Data Integrity :** There is a risk of data tampering or loss due to centralized databases and inadequate audit trails.
5. **Lack of Trust :** Patients may distrust the system due to concerns about data breaches and misuse of their information.

Scope

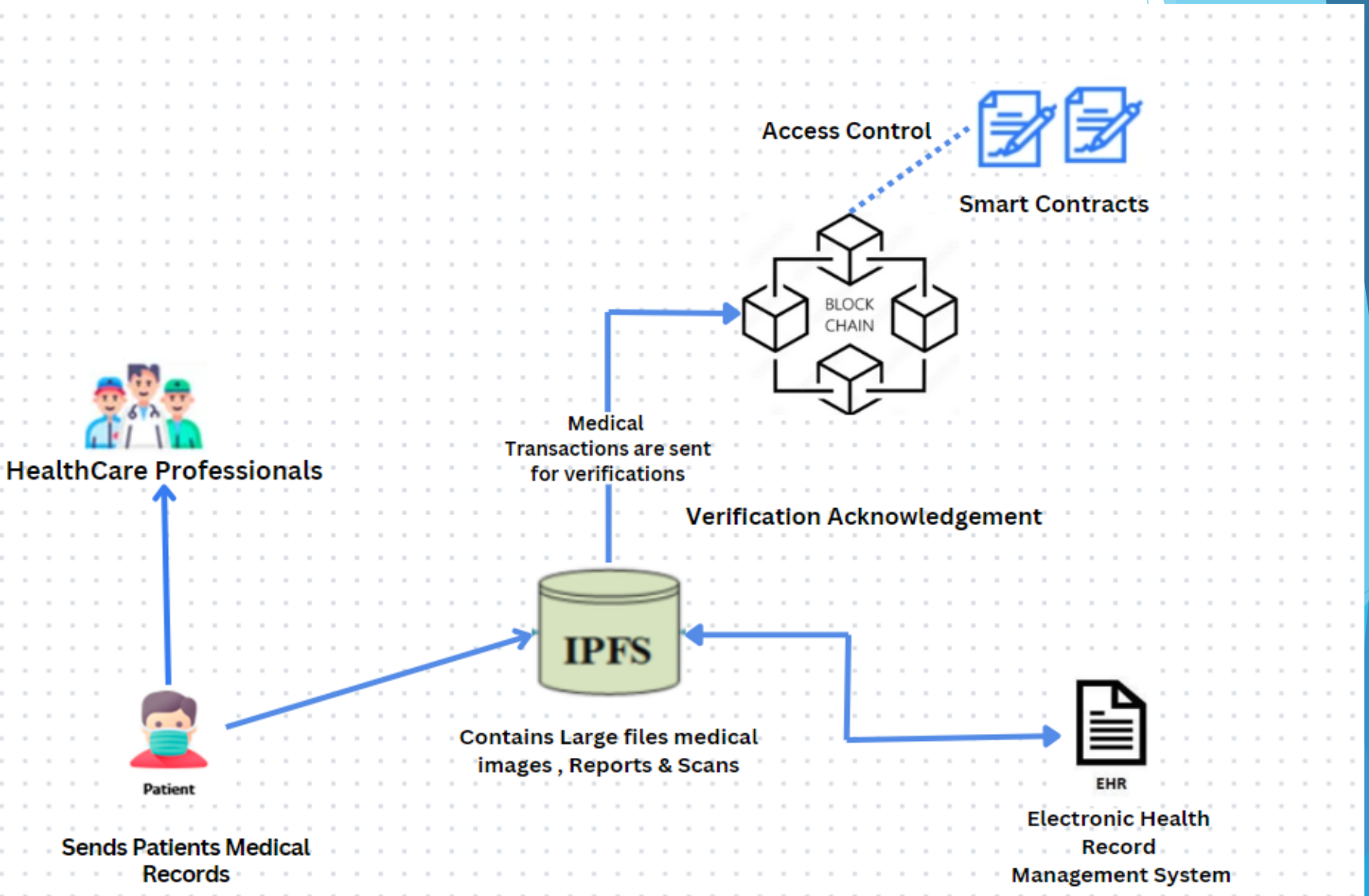
- **Secure and Decentralized Storage**: The system will securely store healthcare records on a blockchain, ensuring that patient data is decentralized, tamper-proof, and protected from unauthorized access.
- **Patient-Centric Data Control**: Patients will have full control over their healthcare data, allowing them to grant or revoke access to healthcare providers, insurance companies, or other authorized entities.
- **Efficient Data Sharing**: The system will facilitate efficient, real-time sharing of patient data between healthcare providers, ensuring quick access to accurate and up-to-date medical information for improved diagnosis and treatment.
- **Immutable Medical History**: Blockchain's immutability will provide a verifiable and permanent history of all patient interactions, diagnoses, treatments, and changes to medical records, ensuring data transparency and trust.

Technological Stack

- **Frontend :**
  1. HTML, CSS , JS
  2. Web3.Js
- **Backend :**
  1. Node js / Express js
  2. Python (Django)
  3. IPFS
- **Database :**

  MongoDB / NoSQL
- **Algorithms :**
  1. SHA-256 Algorithm
  2. Merkle Tree Algorithm

Proposed system architecture/Working



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Thank You...!!