A Systematic Literature Survey on Electronic Health Record System Using Blockchain

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***Abstract*-**Compared with traditional paper-based medical records , Electronic health records (EHRs) are widely used because of their efficiency, secu- rity, and reducing data redundancy.The Electronic Health Record (EHR) system is a major technolog- ical development in healthcare that has completely changed how patient data is collected, stored, and used. Through the use of cutting-edge digital tech- nologies, the EHR system offers a safe, centralized location for all patient data. Healthcare personnel may easily access, edit, and share patient informa- tion thanks to its user-friendly interfaces, which helps them make more informed clinical decisions and provide better treatment.The system developed using the Ethereum network using Ganache. The measured approach is to store patients data and execute functions in a decentralized system using blockchain smart contracts. To further protect patient privacy and adhere to privacy laws, the system places a high priority on data security and uses strong authentication and encryption mechanisms.

Keywords-Blockchain, Decentralized, Ethereum, Healthcare, Smartcontacts,

I. Introduction

The stage for the exploration of blockchain technology's integration into the healthcare sector, specifically in the context of Electronic Health Records (EHR). It begins by highlighting the essence of blockchain as a decentralized network that operates through peer-to-peer (P2P) technology, emphasizing its distinct lack of a centralized authority or single point of control. Instead, it operates as a network of nodes that collectively maintain the system's functionality. Each transaction within this network is rendered highly secure due to the involvement of network nodes and encryption measures, which provide an extra layer of security.It underscores the duplication of digital records across all nodes in the blockchain network and the requirement for each node to verify the authenticity of transactions before incorporation. The concept of a digital ledger, comprised of multiple interconnected blocks, is explained as it offers a comprehensive account of every transaction.[1]

The relevance of blockchain technology to various sec- tors, including education, manufacturing, and healthcare, is briefly mentioned. It is in healthcare that blockchain's potential becomes evident, particularly in addressing the challenges related to data security, patient privacy, and record management.Ethereum is highlighted for its abil- ity to facilitate smart contracts, which enable secure and automated execution of predefined actions when specific conditions are met. These smart contracts bring logic to the blockchain and have significant relevance in healthcare, particularly for the secure sharing of medical records among healthcare professionals. The fundamental challenges faced by the healthcare industry, such as managing vast volumes of data and concerns related to data security, are identified. The rest of the paper is organized as follows:Section 2 reviews literature survey of different research papers, Sec- tion 3 discuss challenges related to technologies, Section 4 provides an overview of methodologies, Section 5 concludes the paper.

II. Related Work

In the field of Electronic Health Records (EHR) using blockchain technology has shown significant advancements and potential applications. Various studies have explored the integration of blockchain into healthcare systems, focus- ing on enhancing data security, patient privacy, and record

management.The approach provides separate profiles for both patients and healthcare providers, ensuring privacy and security. These initiatives highlight the promise of blockchain in addressing critical challenges in the healthcare industry.

A. Application Background

The research paper discusses the widespread application of blockchain technology in various sectors, including supply chain management, with a focus on food supply chains. It highlights the challenges in centralized supply chains, such as inefficiency, insecurity, and fraud. Proposes the use of blockchain technology to address these issues by ensuring transparency, traceability, and security throughout the food supply chain.This technology has the potential to prevent food fraud, ensure product quality, and enhance food safety. The paper also mentions other industries that have implemented blockchain technology for their products.[2]

This study analyzes the use of private and public blockchains for insurance services through the trial and error use of smart contracts built on the Ethereum and Hyperledger Fabric platforms. The Ethereum Blockchain is the foundation for the suggested public insurance smart contract system. In comparison to the prior public approach, the proposed private solution using codechains on Hyperledger Fabric is more adaptable, more secure, quicker, and less expensive.[3]

In this research paper, the author introduces the concept of using blockchain technology to enhance the security and efficiency of the banking system. They argue that a centralized database used in traditional banking systems is vulnerable to attacks, and propose a decentralized architecture using blockchain to reduce these vulnerabilities. The proposed system does not rely on tokens but instead focuses on the bank's control. The paper discusses the architecture and operation of blockchain technology, presents experimental results showing improved performance. The conclusion emphasizes the potential benefits of blockchain for enhancing the security and reliability of banking systems.[4]

This study proposes a blockchain-based electronic voting system that guarantees voter anonymity while enabling safe and economical elections. Blockchain technology safeguards election security and integrity and paves the road for transparency by presenting a novel means to get over the limitations and adoption issues associated with electronic voting techniques.[5]

B. Technical Background

Traditional methods of record-keeping fall short, lacking robust security measures and efficient data transmission avenues. Addressing these challenges, the proposed blockchain-based Electronic Health Record (EHR) system offers a revolutionary solution. By harnessing blockchain technology and smart contracts, this system ensures a decentralized, secure, and accessible healthcare environment. Patients gain control over their medical records, sharing them securely with healthcare providers and researchers. Utilizing advanced cryptographic techniques, the system guarantees data integrity, protecting against unauthorized access and bolstering defenses, especially health crises like COVID-19 pandemic. This innovative approach not only optimizes data management but also amplifies the efficiency and safety of healthcare services, paving the way for a patient- centric, technologically advanced healthcare paradigm.[1]

The authors discuss the potential of blockchain technology to address interoperability and privacy issues in Electronic Health Records (EHRs). They discuss how blockchain's decentralized and transparent nature can enhance data security and streamline EHR access for patients. However, they also identify critical challenges such as computational inefficiency, potential inequalities in access due to energy demands, and trust concerns among healthcare providers and patients. The authors emphasize the need for interdisciplinary efforts involving data science, public health, and medical communities to tackle these complex issues.[6]

The research paper discusses the development of a system called "DIGICERT" that utilizes blockchain technology and smart contracts to prevent the duplication of digital certificates. They have discussed the workings of blockchain from creation of the genesis node to using clever cryptography in order to hash the nodes present in the network, concepts of blockchain such as the distributed ledger, consensus algorithms and mining.Blockchain is implemented on Ethereum blockchain platform. By this they implemented the system application with login for different users and their specified operation.[7] Blockchain-based architecture users with control over their sensitive health data collected by wearable sensors, allowing them to store access control policies on the blockchain. By utilizing blockchain technology, the system ensures confidentiality through encryption, data integrity through immutability, and availability through distributed storage across miner nodes. The proposed model enables patients to specify who can access their data and under what conditions. While the proposed architecture is still under development, it holds the promise of revolutionizing how patient data is managed, ensuring greater privacy and control for individuals in the realm of e-health applications.[8]

Electronic Health Record (EHR) system, integrating blockchain technology, specifically smart contracts, to enhance data security, authenticity, and time management in managing healthcare data. The researchers designed a secure EHR platform using a decentralized and immutable ledger system, ensuring separate profiles for patients and doctors. Patients could create accounts with unique addresses, guaranteeing privacy and security.[9] Propose the implementation of a Blockchain-based EHR challenges such as data privacy, accessibility, and interop-erability. System allows secure storage and management of medical records, ensuring that patient data is accessible

only to authorized stakeholders. Enhances data privacy through cryptography, allowing patients to control and authenticate access to their medical records. The architecture involves various stakeholders, including patients, doctors, hospitals, laboratories, pharmacies, and insurers, ensuring a secure and transparent exchange of medical information. The solution offers significant advantages, such as improved accessibility, data confidentiality, cost-effectiveness, and trust in the healthcare information system. Overall, the proposed Blockchain-based EHR framework demonstrates a promising approach to revolutionizing medical record management, ensuring security, privacy, and efficiency in healthcare data exchange.[10]

III. Challenges

Within the domain of blockchain technology, a formidable challenge has emerged, centered around its inherent constraints in effectively storing large data, particularly multimedia files like images and videos. While blockchain is renowned for its impeccable data integrity and security, it grapples with the task of accommodating extensive multimedia content. This challenge has compelled researchers and innovators to seek a solution that can harmoniously combine the security and immutability of blockchain with the expansive storage requirements of multimedia data.

In response to this substantial challenge, our research paper embarks on a thorough exploration of potential solutions. We painstakingly analyze various approaches, consid- ering their strengths and limitations, to address this critical issue. After careful examination, we unveil a groundbreak- ing solution - the innovative utilization of the InterPlane- tary File System (IPFS). This integration serves as a robust and efficient means to seamlessly incorporate large data storage into the blockchain ecosystem. The transformative synergy achieved by this merger not only surmounts the immediate challenge but also sets the stage for an exciting future of decentralized, data-rich applications.

IV. Methodologies

The benefits of the software platform used to construct this framework. The next part also includes descriptions of the two most well-known and significant implementation components of this framework: Ethereum and Interplane- tary File System (IPFS). [1]

A. Ethereum

Ethereum plays a pivotal role in the world of blockchain as a decentralized platform that enables smart contracts and decentralized applications (DApps). It's a blockchain network designed not just for cryptocurrency transactions (like Bitcoin) but also for executing code in a trustless and secure manner. Ethereum's native cryptocurrency, Ether (ETH), powers these smart contracts and transactions, serving as both a digital currency and a fuel for executing operations on the network. This innovative approach to blockchain has led to the creation of a wide range of applications, from decentralized finance (DeFi) platforms to non-fungible tokens (NFTs) and more, making Ethereum a driving force in the evolution of blockchain technology.

B. Smart Contract

A smart contract is a set of instructions that may be utilized to carry out any blockchain transaction. Users send transactions, which triggers the execution of this function. They are immune to manipulation and change since they run their operations directly on the blockchain. Contracts can use the Solidity programming language to program any type of blockchain activity. Once the programmers have finished all the required tasks, they can put together the program. They might then be put to use. after compila- tion, stored on the Ethereum network. Programming in JavaScript leverages Ethereum's Solidity to write the code for the smart contract.

C. InterPlanetary File System

IPFS enables peer-to-peer distributed data storage across a network. As IPFS data is secure and unchangeable, any attempt to modify it needs to modify the identity. As a result, it offers a cryptographic identity to stop data manipulation. Each data file on IPFS has a cryptographi- cally generated hash value. It is used to identify data files saved on IPFS and has a single value. Using a peer-to- peer connection, the IPFS protocol communicates with an IPFS object that holds data and links.The data consists of a range of disjointed binary values, and the connection is a disordered binary value.

D. Ganache

It's a local Ethereum blockchain made to enable developers to make decentralized applications fast. Ganache can be used to develop, test, and deploy in a dependable and secure environment at any stage of the development cycle. It can be used as a desktop application or as a command- line tool.

E. MetaMask

It's a point of entry that allows you to view the decentral- ized web of the future in real time within your browser. It removes the requirement that decentralized Ethereum apps require you to create a full Ethereum node in your browser.

V. Conclusion

In conclusion, the proposed Electronic Health Record (EHR) system leverages cutting-edge digital technologies, including blockchain and smart contracts, to revolutionize the healthcare sector. It offers a secure, decentralized, and user-friendly platform for storing and managing patient data while prioritizing data security and patient privacy. The integration of Ethereum and smart contracts ensures that patient records are accessible, shareable, and tamper- resistant, allowing healthcare professionals to make more informed clinical decisions. The architecture addresses critical healthcare data challenges while embracing the benefits of blockchain, such as decentralization, security, privacy, and data integrity. The integration of the InterPlanetary File System (IPFS) addresses the challenge of storing large multimedia files, further enhancing the system's capabili- ties. This innovative approach sets the stage for a patient- centric, technologically advanced healthcare paradigm.

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