Decentralized Medical Record Management with Blockchain Technology and Artificial Intelligence

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Abstract: *The objective of this undertaking is to make a decentralized and straightforward clinical records the executives framework utilizing blockchain innovation. The undertaking intends to work on the respectability, security and openness of clinical records by decentralizing them. The objective is to engage individuals with more command over their medical services data, work with consistent and secure information dividing among approved elements and drive development in the field of medical services examination and investigation. The objective of the venture is to assist with making a cutting edge patient-centered medical services environment that puts protection, effectiveness and the smooth trade of wellbeing data at the focal point of all that we do. This theoretical exemplifies the quintessence of the undertaking, framing its goals, philosophy, and expected influence on medical services frameworks. We will likewise give an outline of what is right now had some significant awareness of decentralized clinical records the board utilizing blockchain innovation, as well as certain thoughts for additional exploration and execution.*

Keywords: Decentralized, Privacy, Accessibility, Secure Sharing, Patient-Centric Healthcare, Transparency, Interoperability

I. INTRODUCTION

Lately, the scene of medical care the board has gone through a change that has prompted the improvement of blockchain innovation. The conventional worldview, described by incorporated frameworks, has confronted consistent difficulties to safeguard patient security, guarantee information honesty and work with consistent cooperation between medical services partners. Perceiving these constraints, this study starts research on decentralized patient information the board utilizing blockchain innovation as an inventive answer for these major problems.

The spread of blockchain advancement has offered unprecedented opportunities to agitate the limit, use and sharing of clinical information. Using the intrinsic properties of blockchain, including its security, straightforwardness and constancy, the endeavor hopes to rename the development of patient data the leaders. Making some separation from customary bound together structures, the survey intends to present one more time of decentralized models that attention on security, insurance and prosperity data.

At the core of the venture, blockchain is utilized as a safe and straightforward computerized record that upholds the capacity and access of patient information. Utilizing blockchain cryptographic strategies and agreement systems, research guarantees information respectability, makes sealed records and mechanizes access control through brilliant agreements. This inventive methodology not just addresses the innate weaknesses of concentrated frameworks, yet in addition establishes the groundwork for a strong and adaptable foundation that safeguards patient protection and privacy.

Also, the review intends to enable patients by giving them more independence and command over their patient data. Decentralization enables individuals to specifically impart their wellbeing data to medical care suppliers, advancing a patient-focused way to deal with wellbeing the board. This shift toward patient strengthening expands trust and straightforwardness, yet in addition empowers dynamic support in wellbeing navigation.

In view of these contemplations, the review has two principal goals: to examine the achievability and viability of decentralized patient information the board utilizing blockchain innovation, and to survey its effect on security, protection and patient strengthening in the medical care environment. By investigating the groundbreaking capability of

blockchain development in medical services the board, the review means to lay the basis for a cutting edge patient-focused medical care worldview that focuses on protection, effectiveness and cooperative consideration.

II. LITERATURE REVIEW

As shown by Andre'da Costa et al. [1], the presentation of a blockchain-based individual prosperity record execution" circulated in the Journal of Biomedical Informatics revolves around the execution and evaluation of a Singular Prosperity Record (PHR) model that directions conveyed prosperity records using blockchain development and the openEHR interoperability standard. The survey presents the OmniPHR designing model, which maintains the execution of a scattered and interoperable PHR. The methodologies included executing a model and surveying the blend and execution of clinical records from different creation data bases. The evaluation models focused in on non-utilitarian execution essentials, for instance, response time, PC processor use, memory occupation, circle, and association use. Results exhibited that data conveyed through a blockchain could be recovered with low typical response time and high openness. The survey showed the way that the OmniPHR model execution can organize passed on data into a united viewpoint on prosperity records.

The [2] paper presents a proposed blockchain-based open encryption contrive for electronic prosperity records (EHRs) sharing, intending to address the troubles of securely sharing sensitive clinical data. The paper includes the conceivable use of blockchain development to ensure data uprightness, against changing, and detectability of EHRs' rundown. It underlines the necessity for a strong and confidential pursuit plot without requiring further affirmation and familiarizes a respectability instrument with guarantee that fair clients get definite filed records. The proposed contrive maintains complex Boolean verbalizations and arrive at questions, rather than existing plans that principal assist with singling expression search. The show appraisal shows the adequacy of the proposed plot to the extent that record advancement, search time, or more achieved during the extraction of EHRs.

[3] Blockchain Security Construction for Electronic Prosperity Records of Patients This paper proposes a blockchain security framework (BSF) to securely store and shield electronic prosperity records (EHRs) of patients. It keeps an eye on the security and assurance issues related with EHR information by including blockchain development to spread information in a decentralized manner. The proposed framework changes data security, patient interest, and predictable joint effort with provider data, while thinking about secure permission to clinical information for subject matter experts, patients, and insurance trained professionals. Proliferation results show the feasibility of the framework in defending EHR data. The usage of blockchain development offers a strong and decentralized reply for changing transparency and security of EHRs in the clinical benefits region.

In [4] the article investigates the capability of blockchain innovation to work on the administration and capacity of electronic wellbeing records (EHRs) in the general wellbeing area. The article makes sense of the essential ideas and highlights of blockchain innovation, like encryption, hashing, changelessness, straightforwardness and decentralization. It likewise recognizes various sorts of blockchain, for example, permissionless, permissioned and private. The article gives instances of how blockchain innovation is being utilized in different fields and areas, like money, legitimate, training, social, coordinated factors, media and medical services. It likewise talks about the difficulties and chances of blockchain reception, like security, manageability, trust, regulation and guideline, and administration. The article proposes another model of utilizing a permissioned blockchain to oversee and store the EHRs of enrolled patients. It contends that this framework would give advantages, for example, information respectability, access control, interoperability and effectiveness. It likewise breaks down a contextual investigation of Medicalchain, a stage that utilizes blockchain to empower telemedicine and information sharing.

This [5] paper addresses the challenges of medical data sharing in edge computing environments, such as real-time performance, security, stability, and computational efficiency. The paper introduces a blockchain-based framework for trustworthy medical data sharing, using CP-ABE for fine-grained access control, distributed attribute authorization, distributed key generation, and distributed modular exponentiation outsourcing. The paper establishes the IND-CPA security of the framework in the Random Oracle Model and proves its correctness and zero-knowledge properties.The paper demonstrates the effectiveness and efficiency of the framework for resource-constrained end-user devices in edge computing environments. The creators demonstrate the security of their BTDS design

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DOI: 10.48175/IJARSCT-15431

ISSN
2581-9429
IJARSCT

234

IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Volume 4, Issue 2, February 2024

Impact Factor: 7.53

under the Arbitrary Prophet Model, in light of the q-BDHE suspicion and the Decisional Straight assumption1. They show that their plan is secure against picked plaintext assaults, key-assignment misuse, and key-spillage assaults.

The [6] article proposes a framework that utilizes blockchain innovation and brilliant agreements to upgrade the security, protection, interoperability, and execution of electronic wellbeing records (EHRs). The framework permits patients to control their own information and offer it with medical services suppliers upon demand. The framework is tried on a confidential Ethereum network utilizing Ganache and shows promising outcomes.The article discusses the challenges and limitations of traditional EHR systems, such as data breaches, data hoarding, data exchange delays, and lack of interoperability. It also reviews the existing literature on blockchain-based solutions for EHRs and identifies the research gap and motivation for the proposed system. The article approaches the primary responsibilities and focuses of the survey, which are to design and execute a patient-driven EHR online connection point, integrate it with the Ethereum blockchain stage and smart agreement, ensure the security, insurance, interoperability, and execution of the system, and carry out assessments to evaluate the structure. he makers review a couple of existing plans that usage blockchain development to engage secure and interoperable sharing of electronic clinical records among different performers in the clinical consideration system.

This research [7] presents a patient-centric design of a decentralized healthcare management system with blockchain-based EHR using javascript-based smart contracts[1][1]. It also implements a prototype based on hyperledger fabric and composer technology and evaluates its performance using hyperledger caliper.It reviews the state-of-the-art research works related to blockchain for healthcare applications, focusing on the issues of data privacy, security, access control, interoperability, and patient-centricity. It identifies the research gaps and the main contributions of the proposed approach. The article describes the system architecture for the proposed framework, which consists of five modules, each representing a functional component of the healthcare system. It also defines the participants, assets, and transactions involved in the network and their interactions. The paper centers around the uses of blockchain innovation in the medical care space, for example, electronic wellbeing records, profound advancing as a help, and information sharing .The paper proposes an original patient-driven engineering structure for blockchain-empowered medical services applications, which intends to work on the security, protection, and interoperability of wellbeing information..

The paper [8] talks about how blockchain innovation can be utilized to change the EHR frameworks and settle the issues of information security, trustworthiness and the board. It presents a structure that utilizes blockchain and off-bind capacity to give a versatile, secure and basic answer for EHR. The paper sums up the essentials of blockchain innovation, like block, agreement calculation, key highlights, and difficulties. It likewise presents a few related ideas, like brilliant agreements, Ethereum, and IPFS. The paper surveys a few existing examinations on the uses of blockchain in medical care and biomedical spaces, as well as the strategies to address the versatility issue of blockchain. It additionally recognizes the holes and limits of the past works. This recreates various quantities of clients and solicitations to gauge the reaction time, throughput, and normal inactivity of the framework. They report that the framework has low reaction time and inertness, and high throughput, showing its effectiveness and versatility.

This systematic review [9] presents the motivation, contributions, and roadmap of their paper, which proposes a blockchain-based medical care information the executives framework called HealthBlock. The authors review the existing literature on utilizing blockchain innovation for securing and sharing electronic healthcare records (EHRs) and remote patient monitoring (RPM) data. The authors describe the layered architecture of HealthBlock, which consists of IoT devices, connectivity, off-chain database, blockchain network, application, and users. They also explain the deployment, interaction, and execution models of their system. The authors measure the read and transaction throughput of their system by varying the send rate of transactions per second (TPS). It defines the network latency as the complete time taken for an exchange to be executed in the blockchain network, and divide it into two categories: transaction and read latency. They evaluate the resource utilization of their system in terms of CPU, memory, and traffic, and show that their system outperforms other permissioned blockchain platforms.

The study[10] presents a novel approach to store and share electronic medical records (EMR) using blockchain technology, which is decentralized, distributed, and tamper-resistant. The authors fostered a blockchain framework called Medichain, which permits clients to transfer, validate, and access EMR in in a protected and straightforward manner. Medichain uses crpyptographic hashes, proof of work, and Merkle trees to guarantee information honesty and security. The paper identifies three main problems in the current healthcare system: difficulty in sharing health data,

lack of patient participation, and erroneous clinical decisions. It likewise surveys the current writing on blockchain innovation and its applications in different areas, particularly in medical services. The paper describes the plan and execution of the blockchain compartment, the order line interface, the verification of work calculation, the legitimacy check, and the Merkle tree structure.

The paper [11] introduces blockchain technology as a solid and dependable stage for information sharing and management in various application areas, especially healthcare. It reviews existing literature and applications of blockchain for healthcare, and proposes multiple workflows using smart contracts for better data management. It explains the basic concepts and features of blockchain technology, such as distributed ledger, consensus algorithm, immutability, and decentralization. It also traces the origin and evolution of blockchain from Bitcoin to Ethereum and other platforms. The article surveys the current research and development of blockchain-based applications for healthcare, such as data sharing, data storage, electronic health records, consent management, and clinical trials. it likewise examines the difficulties and opportunities of blockchain for healthcare innovation. The web page proposes a framework that permits clients to run clinical trial-related smart contracts on an Ethereum network, resulting in safer medicines and increased public interest in medical research. The framework utilizes metadata stored on the blockchain to identify potential patients for trials and reward them for participating and sharing their data. The system records patient consent, medical clearance, surgery scheduling, pre-operative testing and payment using smart contracts.

This paper [12] The authors propose a decentralized patient-centric report and clinical picture the executives framework in view of blockchain and IPFS technologies. They aim to address the challenges of data storage, privacy, and access control in the healthcare domain.The authors review the background and motivation of their research, such as the benefits and limitations of information technology, electronic health records, cloud services, and blockchain in healthcare. It uses the Ganache Truffle Suite package to make an individual Ethereum blockchain for testing and managing the chain operations. The authors presented a pseudocode for the interface module that handles the event-based functions for data sharing and analytics. The module checks the user type (doctor or patient), the test type (blood or lipid), and the report availability before updating the dashboard. The authors illustrated the stack of tools and technologies used for the system implementation, such as Solidity, Ethereum, Metamask, and IPFS. They explained the roles and functions of each tool in the system.

[13]The authors propose a solution for personal health records (PHRs) in light of blockchain technology, which allows patients to own and control their data, and share it with healthcare providers and researchers securely and efficiently. The authors review the existing literature and identify the gaps and challenges in the field of PHRs, such as data ownership, access control, privacy, security, and scalability. They also justify the need for more research and stakeholder engagement to develop practical and viable solutions. The authors state their principal goals, which are to identify the key requirements for PHRs, to plan and create a high- and low-level architecture based on Hyperledger Fabric framework, to implement a working prototype, and to evaluate its functionality and performance. The authors summarize their main contributions, which include proposing a PHR solution based on blockchain, introducing Hyperledger Fabric to achieve access control and identity management, designing and developing a prototype, engaging stakeholders to elicit requirements, and evaluating the system using Hyperledger Caliper tool. Mobility and decentralized storage are essential for mobile health applications, as they allow patients to access their health records anywhere and anytime, and also provide faster and safer data access without a single point of failure.Performance, scalability, and availability are important for ensuring the usability and reliability of the system, as well as the efficiency and effectiveness of the data processing and sharing.Security and privacy are critical for protecting the patient's data from unauthorized access, leakage, or malicious attacks, and also for providing access control and traceability features.

TABLE I. Table of Comparison Results

Sl no	Author/year	Research /Work Paper	Objective	Technology	Achieved	Not Achieved
1	Andre da Costa *et al.*	Analysing the performance of a blockchain based personal health record implementation. [1]	Implementation and evaluation of a Personal Health Record model that utilises Blockchain.	Hyper Ledger Fabric Ethereum Apache Kafka Apache Zookeeper	Leverage Blockchain technology and the open HER interoperability standard to integrate distributed health records Enhance the proficiency of data replication and distribution within the medical services framework.	Lack of specific information in technical aspects of implementation
2	Drew Ivan	Moving Toward a Blockchain-based Method for the Secure Storage of Patient Records. [14]	The document provides an overview of blockchain technology and its benefits for health data, compares it with the current methods of record keeping and sharing, and suggests a bridge solution of a blockchain-based personal health record (PHR) that can coexist with the existing health IT systems.	Blockchain, a decentralized, distributed, and immutable ledger of transactions that can store and share health data securely and efficiently	The document provides an overview of blockchain technology and its benefits for health data, compares it with the current methods of record keeping and sharing, and suggests a bridge solution of a blockchain-based personal health record (PHR) that can coexist with the existing health IT systems	The document does not provide a concrete implementation plan or timeline for the blockchain solution, nor does it address the legal, ethical, and social implications of using blockchain for health data. It also does not evaluate the performance, scalability, and usability of the blockchain solution
3	Sanjeev Kumar Dwivedi, Ruhul Amin, *et al.*	Blockchain-Based Electronic Medical Records System Contract and Consensus Algorithm in Cloud Environment. [15]	To propose a blockchain-based framework for EMR systems that provides decentralization, security, privacy, access control, and authenticity of patient data2. To design a smart	Blockchain, smart contract, cloud computing, electronic medical records (EMRs)	The authors presented a novel architecture for EMR systems using blockchain technology and cloud storage. They also proposed a state machine model for smart contracts and a	The creators didn't give any experimental evaluation or implementation details of their framework. They did not address the scalability and performance issues of their approach.

		contract and a consensus algorithm for the proposed framework3.		consensus mechanism based on hash generators. They talked about the benefits and challenges of their approach and compared it with existing arrangements	They did not consider the incentive mechanism and the mitigation of different assaults that might influence the security of the EMR system4
4	Mohammad Moussa Madine, Ammar Ayman Battah, *et al*.	Blockchain for Giving Patients Control Over Their Medical Records [16]	To propose a blockchain-based architecture to manage access control of personal health records (PHRs) in a decentralized, immutable, transparent, traceable, trustful, and secure manner2. To give patients full control and responsibility for their clinical information and empower them to share it with their doctors. To integrate multiple technologies to overcome the constraints of blockchain in terms of huge - size data storage and program execution	Ethereum blockchain, smart contracts, proxy re-encryption, trusted oracles, reputation system, and IPFS1	The authors have developed and implemented two smart contracts in Solidity language to enable decentralized access control for PHRs between a patient and a doctor. They have presented algorithms along with their full implementation details5. They have evaluated the proposed smart contracts. They have also provided security analysis	The authors have not tested their solution on a real-world blockchain ecosystem or with real medical data. They have not addressed some aspects of PHR management, such as standardization of medical record file formats, digital rights management. They have not compared their solution with existing solutions in terms of scalability, efficiency, and usability. They have not considered the ethical, legal, and social implications of their solution
5	Abdullah Al Mamun, Sami Azam, *et al*.	Blockchain-Based Electronic Health Records Management: A Comprehensive Review and	To conduct a systematic literature review of blockchain-based solutions for EHRs management, to	Blockchain, a distributed and decentralized ledger technology	Proposed blockchain-based solutions for EHRs management, analyzed them based on privacy, security, scalability,	The authors did not provide a quantitative comparison or evaluation of the existing solutions, nor did they

		Future Research Direction [17]	evaluate them based on various criteria, and to identify future research directions		accessibility, cost, consensus algorithms, and type of blockchain, and discussed the advantages and limitations of blockchain technology for EHRs management. They also provided some potential research directions, such as combining blockchain with artificial intelligence, internet of medical things, and attribute-based encryption.	implement or test any of the proposed solutions. They additionally didn't address some of the challenges and open issues of blockchain technology, such as interoperability, standardization, regulation, and governance
6	Gaganjeet Singh Reen, Manasi Mohandas et al. (2021)	Decentralized Patient Centric e-Health Record Management System using Blockchain and IPFS [18]	The document aims to address the following problems of the current EHR systems,lack of privacy and security of patient data,Lack of patient control over their own records,Lack of uniformity and interoperability of records across different hospitals	Ethereum blockchain, smart contracts, IPFS (Inter Planetary File System), and biometric encryption to store and access electronic health records	Provide patients with full control over their records and allow them to grant or revoke access to hospitals as they wish[56] Ensure the immutability and integrity of records by using IPFS and blockchain Enable the verification of record creation and access by using smart contracts and digital signatures	Prevent the hospital from copying or photographing the records when they have access to them Ensure the adoption and usability of the system in developing countries where internet access and digital literacy are low Ensure the deletion of all copies of a record from the IPFS network when the patient revokes access
7	Vinodhini Mani, Prakash Manickam, et al. (2021)	Hyperledger Healthchain: Patient-Centric IPFS-Based Storage of Health Records. [19]	The document aims to develop a patient-centric healthcare data management (PCHDM) framework that allows patients to have complete	blockchain technology, Hyperledger Fabric	An off-chain database that encrypts the actual health data and stores it in IPFS, which is a decentralized cloud storage system that ensures scalability,	The document does not provide a comprehensive analysis of the security and privacy threats that the proposed framework may face, such as malicious nodes,

IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Volume 4, Issue 2, February 2024

Impact Factor: 7.53

			control and ownership of their health records, and to share them with authorized stakeholders in a secure and efficient way. The document also aims to evaluate the performance of the proposed framework under Hyperledger caliper benchmarks and compare it with existing systems.		confidentiality, and resolves the problem of blockchain data storage. .	collusion attacks, or data leakage. The document also does not address the potential legal and ethical issues that may arise from the use of blockchain technology in healthcare, such as data ownership, consent, and liabili
8	Ray Hales Hylock et al. (2020)	A Blockchain Framework for Patient-Centered Health Records and Exchange (HealthChain): Evaluation and Proof-of-Concept Study [20]	To present HealthChain, a novel patient-centered blockchain framework that aims to improve patient data access, accumulation, contribution, exchange, and control in a secure, interoperable environment. To evaluate the performance and security of the framework using a proof-of-concept tool and various configurations.	Blockchain, chameleon hashing, proxy re-encryption, smart contracts,	The authors proposed a detailed design of HealthChain, which consists of six components: patient centered, permissioned blockchain, interoperability, mixed-block blockchain, smart contracts.	The authors did not provide a comprehensive evaluation of the framework in terms of scalability, usability, user satisfaction, and clinical outcomes. They also did not compare their framework with existing or alternative solutions for patient-centered health records and exchange.
9	Prof. Rohini Hanchate, Samriddhi Garudik et	Blockchain for Giving Patients Control Over Their Healthcare	To make an architecture for the EHR system using blockchain technology and to	Blockchain technology, web technologies such as	To create an EHR system using the concept of blockchain and to deploy the project	The need for a large number of nodes and computational resources to maintain the blockchain

	al. (2020)	Records". [21]	propose a framework for the blockchain and create a block to store the patients' data in a decentralized healthcare network for secure sharing	HTML, CSS, JavaScript, PHP, and SQL for the implementation of the system.	using web technologies[4]. To map EHR components to the requirements of the system and to treat patient data as assets that are stored in the ledger[7]. To provide extra steps in the application for patients to decide who can access their information and to view and edit their personal and medical details.	network and to ensure its scalability and performance. The difficulty of integrating the proposed system with the existing EHR systems and the need for more standardization and interoperability among different platforms and stakeholders.
10	Elias Hossain, Rajib Rana et al.	Natural Language Processing in Electronic Health Records in relation to healthcare decision-making: A systematic review [22]	The document aims to review the current state-of-the-art of natural language processing in electronic health records, with a focus on different model`s, applications, challenges, and opportunities.	Machine learning, deep learning and natural language processing techniques to analyse electronic health records and extract clinical insights.	The document provides a comprehensive and updated overview of the various healthcare uses of natural language processing in electronic health records. The document also discusses the potential implications and future directions of natural language processing for healthcare decision-making	The document does not provide a quantitative or qualitative comparison of the performance of different natural language processing models or techniques. The record likewise does not address the ethical, legal, or social issues related to natural language processing in electronic health records. The record additionally does exclude any case studies or real-world applications of natural language processing in healthcare settings.

III. CONCLUSION

In conclusion, the analysis of blockchain technology's decentralized medical record management has shown that it has the capacity to completely transform healthcare systems. Key trends and obstacles have been discovered through a review of previous research and a comparative comparison of methods, input datasets, and aims.

Although decentralized approaches present encouraging answers to problems like patient empowerment and data security, obstacles like scalability constraints and legal worries still need to be addressed. However, this study highlights the revolutionary effect of decentralised medical records management and stresses the necessity of additional investigation and cooperation to achieve its complete potential in enhancing patient outcomes and healthcare delivery globally.

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