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E.H.R. System on Big Data Model Using Blockchain

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ABSTRACT

The amount of data generated by various computer applications is increasing rapidly and disrupting predictable data processing and analytics functions, which was previously handled well by the cloud. Blockchain technology eliminates the need for a centralized authority to ensure information integrity and ownership, allowing safe and direct transactions between participants. It has important qualities such as immutability, decentralization, and openness that can help address critical healthcare challenges such as incomplete records and restricted access to patient data. Interoperability is crucial for an efficient healthcare system as it enables different software applications and platforms to communicate securely, exchange data, and use the exchanged data across healthcare organizations and app vendors. Blockchain provides access to complete and consistent medical records kept in fragmented systems in a secure and pseudo-anonymous manner. This project aims to implement blockchain in a distributed computing environment and develop an automatic recovery system for invalid chains. Additionally, it will assess the impact of security vulnerabilities and potential solutions, and provide future directions for individuals responsible for building, developing, and managing distributed systems.

Keyword: - Blockchain Technology, Decentralization, Decentralized System, Distributed Computing, Peer-to-Peer Network, Healthcare.

1. INTRODUCTION

A blockchain system is a secure database for storing essential medical data that is almost impossible to corrupt due to its cryptographic nature. The system is maintained by a network of computers and is accessible to anyone with the software. While it ensures data integrity, blockchain is a pseudo-anonymous system with privacy issues as all transactions are visible to the public. Proper access control is required for managing the healthcare records of heterogeneous patients across multiple facilities and devices.

Blockchain was not designed as a large-scale storage solution, and a decentralized storage solution could complement its weaknesses in the healthcare industry. The blockchain network is more resilient than centralized solutions because it is a decentralized system without a single point of failure. However, since all bitcoin transactions are public, analytics tools can identify network users based on transaction history. Popularity analytics can be used to identify similarities or closeness among themes within a large volume of data. Formulating a closeness relationship can create groups of objects or themes.

The digitalization of information paved the way for the digital revolution of money, which was built on the popular client-server architecture of the internet. Services such as PayPal were created to facilitate direct financial transactions between individuals (C2C). However, these systems rely on the server's claims about a user's available funds, and they lack complete transparency, which can lead to fraudulent activities by entities operating behind the scenes. While these systems currently work because the server operators have incentives to act ethically, there is a constant search for better solutions to enhance trust and transparency.

Blockchain technology has six fundamental components that make it distinct and valuable. Firstly, it is decentralized, meaning there is no need for a central server as all nodes in a peer-to-peer (P2P) system contribute resources equally. Secondly, it is transparent, allowing all stakeholders to access the data stored in the blockchain. Thirdly, it is open source, which enables unrestricted creation of applications. Fourthly, it is autonomous, relying on a consensus protocol that allows any node to safely transfer or update data without trusting a specific individual. Fifthly, it is immutable, meaning any data stored in a blockchain cannot be deleted or changed unless a single party controls over 51% of the network nodes. Finally, it provides anonymity by requiring only the recipient's blockchain address to complete a transaction, without revealing the owner's actual IP address.

2. OBJECTIVES

- The aim of this study is to gather and analyze existing academic material on the integration of EHRs and blockchain technology, and to identify potential areas for development.
- EHRs have become an efficient way of sharing patient data across different hospitals, but accessing this data from multiple EHRs can be challenging.

- The objective is to create a system that can access patient records easily and securely across different EHRs without relying on a centralized authority.
- The primary focus is to explore the use of blockchain technology in EHRs, including the benefits and challenges it presents.

3. LITERATURE REVIEW

There is a significant amount of literature available discussing the use of blockchain technology in healthcare. In 2015, blockchain became popular as a novel economic model [1] and for decentralizing privacy [2]. The following year, blockchain and electronic patient record systems (EPRS) [4] were utilized to empower the patient-physician relationship [4]. Azaria et al. [5] described the use of blockchain for handling authorization in the medical domain, with their developed application called Medrec. Interoperability solutions were also cited [6]. In 2017, blockchain rapidly evolved [7] and was utilized in various healthcare applications [8], [9], [10]. Blockchain has been shown to be highly promising for healthcare [11] and has had a significant impact on e-health [12]. Many previous works have discussed the challenges and opportunities of blockchain in e-healthcare [13], [14]. Esposito et al. [15] showed that in 2018, blockchain gained celebrity status as an assurance for offering security and privacy of eHealthcare. There are several notable blockchain systems, including Blochie [16], FHIRchain [17], and Mistore [18]. Other works of interest include the AuthPrivacyChain [19], a blockchain-based access control framework with privacy protection, the blockchain-empowered AAA scheme for accessing data of LS-HetNet [20] proposed by Shi et al., and the zkCrowd [21], an innovative hybrid blockchain crowdsourcing platform proposed by Zhu et al.

A brief summary of the existing research done on EHR adopting different technologies is shown in a table below:

Table -1: An overview of existing research on EHR adopting Blockchain Technologies.

Sr No.	Weakness Identified	Proposed solution	Technology Adopted					Research Outcome
			BCT	BIG DATA	IoT	CC	Other	
1	A massive volume of data generated disrupts predictable data processing and analytics functions.	The implementation of blockchain in a distributed computing environment.	Yes	-	-	Yes	-	A decentralized system architecture is proposed with distributed computing
2	Old fashioned paper-based one's health records have very high maintenance as well as it is a time-consuming process.	Blockchain technology can help to build new EHR systems and solve the problems that prevent the adoption of traditional systems.	Yes	-	-	-	Yes	Proposed a consortium blockchain for EHRs, which has advantages over traditional EHR systems
3	Patients are not able to access the records as their access are limited by the organization.	Electronic Health Records for storing information of the patient which consist of the medical reports.	Yes	-	-	-	Yes	Health Records of the patients are more secured with the Blockchain.
4	Central medical servers are low in capacity, and vulnerable to insider attacks. Even patients do not know where the data is stored.	The blockchain technology makes it easy to monitor population health, identify risk as it has updated medical report of the patient.	Yes	-	Yes	-	Yes	The blockchain technology makes it easy to monitor population health throughout the globe.
5	Blockchain data is consider as immutable as data change in one node helps Blockchain in knowing about data leak or alter.	The proposed system is a prototype to get a idea of functioning of blockchain while it is integrated with EHR.	Yes	-	-	-	Yes	In this work an architecture and a methodology based to create an EMR system based on blockchain is proposed.
6	Unauthorized entities may gain malicious access to EHRs without consent of patients.	Deployed a private Ethereum blockchain on AWS. Data access and transactions are recorded and shown on the web interface for monitoring.	Yes	-	Yes	Yes	Yes	We identify critical challenges of current EHRs sharing systems and propose efficient solutions to address these issues through a real prototype implementation.

7	Casts doubt on the usability of blockchain for large-scale purposes due to the disadvantages associated with data processing activities.	The integration strategies utilized to integrate blockchain with IoT.	Yes	-	Yes	-	-	Blockchain technology has the potential to significantly improve a variety of application areas within a smart city.
8	High volume data cannot be optimized with the help of Enterprise database solutions which also needs absolute privacy.	Blockchain solutions are designed to record specific transactional data events	Yes	-	-	-	-	Blockchain technology has the potential to advance HHS's strategic goal and investments to standardize health care information
9	Some of the limitations of Big data revolve around data and its quality.	To use correctly big data analytics, one big step is to set the main goal or end product of the application.	Yes	Yes	-	-	Yes	Blockchain will protect the records, preventing any anomalous alterations.
10	Immutability (transaction cannot be changed once it is agreed and shared across the distributed network).	Health data can be stockpiled on the Block Chain in a safe, way. The Characteristics of Block Chain.	Yes	-	-	Yes	-	Escalating initial expenditure in adopting the new technology.

4. PROPOSED WORK

The future work for this proposed system involves two aspects. Currently, it is only a prototype to understand how blockchain can be integrated with EHR. The first step is to add more participants, such as hospitals and insurance service providers. The next step is to scale up the system and maintain an off-chain database to store real prescriptions in the form of images or other formats. EHR is a unique project that stands out from other similar projects by specializing in using blockchain technology. This technology makes it easier to monitor population health, identify risks, and track trends in the spread of health issues by using updated medical reports of patients.

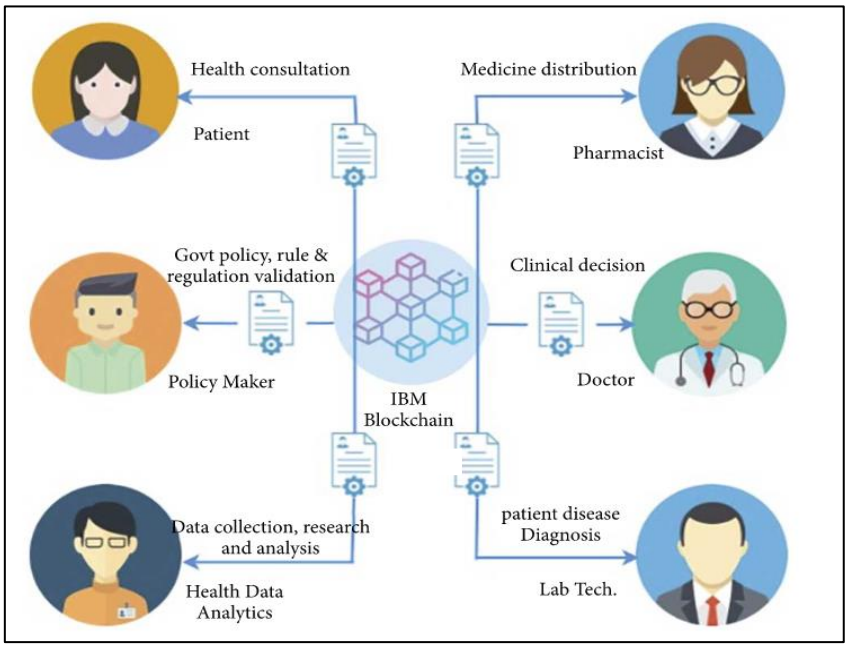

Fig -1: Block Chain in HER

5. CONCLUSIONS

Integrating technologies like EHR, Cloud Storage, IoT with Blockchain can bring various benefits such as reduced cost, automation, and increased security. This integration also addresses the security concerns of using the latest encryption techniques. However, there is a need for substantial research to determine the best design process for developing an interoperable ecosystem that uses Blockchain technology while also addressing crucial security and confidentiality concerns in healthcare. There is also a need for further study on secure and efficient software practices for integrating Blockchain technology in healthcare to educate software developers and domain specialists about its potential.

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