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HEALTHCARE IN THE ERA OF BLOCKCHAIN: REVOLUTIONIZING THE INDUSTRY

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ABSTRACT: It is widely acknowledged that blockchain technology can enhance the security, dependability, and robustness of distributed systems. Blockchain's prospective applications across a variety of industries have garnered widespread recognition.In recent years, this technology has become increasingly pervasive, influencing numerous industries.Through this technology, decentralized and distributed environments can be created in the absence of a central authority.Healthcare is anticipated to be one of the most important application sectors where blockchain will have a significant impact. It has enabled the administration of health care to be more effective and efficient. It helped define the subsequent era's healthcare environment. This industry benefited from the peer-to-peer, secure, and transparent blockchain technologies.Since it enables transparent data examination, authorized data access, and immutability, blockchain can be used to securely manage medical records.

Keywords: Blockchain , Healthcare , Consensus , Distributed systems.

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1. INTRODUCTION

Blockchain is an open, decentralized ledger that tracks occurrences on numerous computers. Changes to an older record affect all subsequent blocks. Developers prefer blockchain because it's decentralized, open, unchangeable, and employs spread ledgers. Blockchain technology is widely used for Bitcoin exchange, safe medical data sharing, model construction for prediction using machine learning and data mining, and identity protection. Privacy and data security are crucial when receiving medical care. Healthcare systems need secure communication tools to function successfully. This is why blockchain is emerging. Figure 1 displays blockchain-enabled health care platforms.
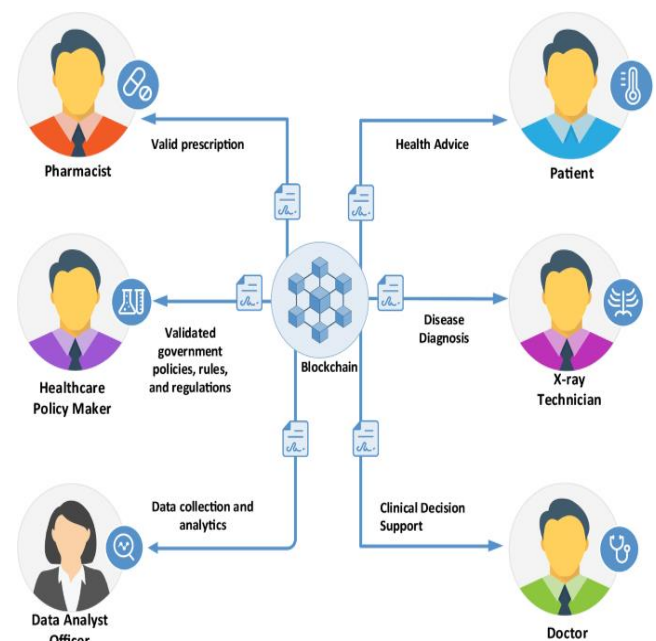

Fig 1. Blockchain-based healthcare systems

The following sections show the chapter structure. Section II summarizes essential work, while

Section III discusses applications. Part IV discusses blockchain's drawbacks in healthcare, while Part V presents the chapter's conclusions.

2.RELATED WORK

Table 1 shows that blockchain technology has accelerated ecosystem expansion and made cross-disciplinary collaboration simpler. Using blockchain, many healthcare prototypes, uses, needs, approaches, benefits, and downsides have been revealed.

Thomas McGhin stated in 2019 that rigorous regulatory requirements necessitate healthcare blockchain apps to be certified, interoperable, and record-sharing. The healthcare industry has specific security concerns include IoT security, wireless security, interoperability, access control, authentication, and non-repudiation. The part stressed data integrity, immutability, and privacy for security. Lack of standards and handling of decentralized privacy breaches are research gaps in the study. Additionally, it has blockchain-specific software issues.

Blockchain technology targets personal and electronic health records, according to Anton Hasselgren's 2020 article. Ethereum and Hyper Ledger Fabric appear to be the most popular platforms. Blockchain technology is growing in healthcare, study shows. Decentralization, anonymity, and persistence are considered the most crucial aspects of blockchain.

In 2018, blockchain technology has many open systems and new agreements, says Marko Kompara. The study also examines healthcare technology's merits, cons, and future. This work aims to generate new framework, structure, and model ideas. It introduces bitcoin and how it secures independent transactions without a central authority.

2020 by YiChian Chen discusses blockchain technology, how it is improving business, and how it could alter healthcare. It described the changes in HIE, Digital Identity Management, Healthcare Supply Chain Management, and medical research data use in healthcare. It also discussed automating banking and insurance transactions.

J. Mikael Eklund (2019) believes blockchain has helped manage identities, resolve disputes, store medical data, and remotely monitor patients.

Blockchain has great potential for cost-effective patient care, according to Leila Ismail (2019). Most people agree on her future predictions for privacy, system risk, scalability, decentralization, and seeing and changing things. The author suggests the Head Blockchain Manager (HBCM) to prevent Bitcoin forking, which is common. HBCM protects and hides the planned architecture. The paper covers blockchain network components such Transactions, Blocks, Merkle tree root cipher, Nodes, and Mining.

In 2018, Liam Bell wrote about how blockchain could improve health and fitness. The study examines clinical trials, data sharing, and pharmaceutical traceability. It discusses sharing healthcare data, tracking medical equipment and pharmaceuticals, and current healthcare industry issues.

EHRs must be strengthened with blockchain technology, according to Ariel Ekblaw (2016). It also highlights how blockchain technology helps MedRec manage identification, privacy, data sharing, and more, which are crucial when handling confidential data. A bug bounty program and security testing are also vital to "UbiHealth".

In 2019, S. J. Miah discusses blockchain apps like Nebula Genomics, Secure Health Chain, and Doc.AI in healthcare. The paper discusses how blockchain in healthcare makes it easier and cheaper for professionals and patients to access information, secure, and reduces errors and data loss. Unlike previous healthcare blockchain systems, it fixed privacy, coordination, timing, and human factors.

Khaled Salah discusses blockchain's benefits in healthcare in 2021. He discusses its future and research issues. Blockchain technology's

immutability, anonymity, programability, distributed record, and data origin tracking have been extensively discussed. It discusses prospects including making drugs, clinical trials, precision medicine, patients, managers, telehealth system security, more health insurance coverage, a better medical billing system, and maintaining permissions easier to find. Case studies and ongoing projects like the Estonian e-health system are highlighted.

Rachid Benlamri discussed blockchain technology in the Internet of Medical Things in 2019. These included data management, storage device connectivity, and data security. The use of blockchain in healthcare administration, data sharing, management, storage, and EHRs are discussed. As a responsible and open online data storage system, blockchain technology offers great promise. The distribution system may potentially tackle healthcare data privacy, security, and integrity issues.

Blockchain can be utilized for e-health and electronic medical data in 2019, says Hannah S. Chen. Telehealth, Healthcare Service Innovation, and software development are among the IT services covered. Data privacy and protection have been prioritized. The study describes how indicator-centric schema (ICS) orders and secures Healthcare Data Gateway (HDG) data.

PsycINFO, PubMed, Scopus, and Web of Sciences have health informatics material, according to Anushusha Tandon (2020). The main modern issues of this study were the development of blockchain architecture and the creation of smart healthcare systems that can predict the future. The author also claims that blockchain apps would improve medical diagnostics, law enforcement, fraud prevention, and remote and emergency patient care. It also describes how the software was created and tested.

In 2019, Asad Ali Siyal said that blockchain technology is gaining popularity in financial services, data management, cyber security, the

IoT, and more. This study examines how clinical decision-making and safe, secure, and scalable (SSS) data sharing affect the healthcare industry. A SWOT analysis breaks out healthcare blockchain technology's strengths, weaknesses, opportunities, and threats.

H. According to M. A common taxonomy should be utilized to examine blockchain technology in healthcare (Hussien, 2019). Federated or group blockchains, private or permissioned blockchains, and public or not-permitted blockchains are discussed for healthcare. Healthcare apps handle medical data security, privacy, integrity, access control, interoperability, and managing massive patient care. This script offers solutions to make blockchains more scalable, secure, quick, and computer-power-efficient.

Asma Hassan (2020) argues blockchain technology can improve personalised healthcare, health data exchange, pharmaceutical supply chain efficiency, and clinical trials. Due to security, scalability, energy, and transaction costs, technical know-how is scarce. Blockchain's pros and cons in healthcare were shown in this effort to help stakeholders, agencies, and groups comprehend it.

According to Jules White (2017), a blockchain-based mobile healthcare app highlights the merits and cons of healthcare connectivity. This essay examines healthcare system integration issues like merging and data storage. It illustrates how to access, edit, and send medical data using the web-based DApp for Smart Health (DASH) interface.

T. Clinical blockchain improves healthcare through data ledgers, speeds up scientific research, and simplifies medical record management, according to T. Kuo (2019). Discussed are Ethereum, Hyperledger, and Multichain, the key blockchain platforms utilized in healthcare. Blockchain platforms including Bitcoin, Zcash, Dash, Ripple, Peercoin, and others are covered in the study. Blockchain applications' "off-the-shelf" features fulfill many health science needs, which was the biggest benefit.

Karan Parekh, 2020 illustrates how blockchain infrastructure might make medical information, device tracking, prescription databases, and hospital assets easier to access, improving healthcare interoperability. It also shows how changing ages have helped the healthcare system flourish. Distributed ledgers, provenance, smart contracts, finality, and consensus procedures help. In 2020, Ahmed Farouk emphasizes the importance of the Internet of Healthcare Things (IoHT) in operational support and healthcare services. The study also advises using IoHT and AR to produce digital copies and give technicians and physicians hands-on training to improve clinical decision-making, safety, and openness. Ledger, cryptography, immutability, consensus mechanism, Merkle trees, assets, and peer-to-peer network are its components.

Table 1: List the proper actions.

S.No.	Year	Title	Outcome
1	2019	Blockchain in Healthcare Applications: Research Challenges and Opportunities	Highlights the various applications of blockchain with their issues and advantages.
2	2020	Blockchain in healthcare and health sciences- A scoping review	Examines how blockchain technology can be used in the area of health care.
3	2018	A Systematic Review of the Use of Blockchain in Healthcare	Highlights the growing importance of blockchain technology in healthcare.
4	2020	Blockchain in Healthcare Innovation: Literature Review and Case Study Business Ecosystem Perspective	Describes how blockchain and its applications in healthcare have evolved and the evolution of stakeholders in the field.
5	2019	Blockchain Technology in Healthcare: A Systematic Review	Depicts the various healthcare use cases with its prototypes.
6	2019	Lightweight Blockchain for Healthcare	It proposes blockchain architecture and its role in different data management systems.
7	2018	Applications of Blockchain Within Healthcare	Highlights the current implementation and issues within the modern healthcare industry.
8	2016	A Case Study for Blockchain in Healthcare: "MedRec" prototype for electronic health records and medical research data	Addresses the MedRec prototypes and its principles in the EHR and medical systems.
9	2019	Blockchain in Healthcare	Several insights about blockchain technologies and their potential applications for healthcare systems are uncovered.
10	2021	Blockchain for healthcare data management: opportunities, challenges, and future recommendations	Provides insights into blockchain technology, its key features, and its application in healthcare.
11	2019	Blockchain Technology in Healthcare: A Comprehensive Review and Directions for Future Research	Describes the open research matters in the fast-growing field with revolutionizing healthcare industry.
12	2019	Blockchain in Healthcare: A Patient-Centered Model	It states about security and accessibility and its use in different healthcare venues and remote applications.
13	2020	Blockchain in healthcare: a systematic literature review, synthesizing framework and future research agenda	The work summarized the thematic trends of academic research on databases in the healthcare field and aimed to highlight their applications and objectives.
14	2019	Applications of Blockchain Technology in Medicine and Healthcare: Challenges and Future Perspectives	States the current and future developments of blockchain in healthcare with its applications and challenges
15	2019	A Systematic Review for Enabling of develop a Blockchain Technology in Healthcare applications: Taxonomy, substantially analysis, Motivations, Challenges, Recommendations and Future Direction	Identifies the various types, uses, solutions, challenges and applications amongst different healthcare sector and medical institutes.
16	2020	The benefits and threats of blockchain technology in healthcare: a scoping review	Discusses how blockchain technology can improve the sharing and storing of healthcare data.
17	2017	Applying Software Patterns to address Interoperability in Blockchain-bases Healthcare Apps	Depicts the features, challenges and software patterns used in developing blockchain based healthcare apps.
18	2019	Comparison of blockchain platforms: a systematic review and healthcare examples	Addresses the benefits, features, methods and development of biomedical blockchain applications
19	2020	Blockchain-based electronic healthcare record system for healthcare 4.0 applications	It proposes an Access Control Policy algorithm for improving and implementing EHR sharing system.
20	2020	Blockchain platform for industrial healthcare: Vision and future opportunities	It summarizes the consensus algorithm with blockchain components and its types in healthcare field.

2.APPLICATION AREAS OF BLOCKCHAIN IN HEALTHCARE

Healthcare manages supply lines, transfers records safely, predicts disease outbreaks, and helps researchers decipher genetic codes.

Patient Data Protection and Security

There are concerns concerning healthcare data security. The blockchain is a distributed, permanent catalog of records. Blockchain technology helps doctors and patients securely

exchange and receive crucial information, while encryptions and complex security codes guarantee privacy and openness. Here are some uses:

Smart contracts enable healthcare providers to track patients. To access the data, you must create a public key, or unique identification.

The clinician needs the patient's public key to access their data. The key or ID must match for the doctor or nurse to access the data.

Smoother transition of patients among Care providers

By sharing a private key, patients can easily unlock and share their health data with other doctors or organizations using the blockchain. Health information technology (HIT) may become more interoperable and improve user collaboration.

Electronic medical records (EMRs)

By storing a common set of data on the chain and private, encrypted links to separately stored data like x-rays or other photos, the blockchain may allow businesses to communicate and receive data safely. Unified permission requirements and smart contracts may simplify communication.

Data Safety

Blockchain security makes health records safer. Individuals have private keys that can only be utilized at specified times.

Cybercrime would stop because people would have to directly target each person for critical information. Blockchains can provide an unchangeable medical data audit trail.

Review of medical personnels

Blockchain technology can reveal doctors' pasts and medicinal supply sources. The main benefits of blockchain technology are listed below.Healthcare groups can receive accreditation faster while hiring.

Security and transparency for partners, such as firms that use locum tenens subcontractors or innovative virtual health care models that teach consumers about doctors' experiences.

3.LIMITATIONSAND CHALLENGES IN THE ADOPTION OF BLOCKCHAIN IN HEALTHCARE

Blockchain technology has various healthcare applications, but it must be fixed first. When implementing blockchain technology, healthcare professionals may encounter the following issues.

Many may struggle to grasp blockchain technology. They need more blockchain apps to comprehend the technology and aren't ready for production. Data processing between insurers and healthcare providers is difficult. Blockchain technology would be impossible to adopt without this strategy.

The collected health and medical data requires a lot of space. Blockchain may not be suitable for healthcare IT systems in small and medium-sized organizations.

Blockchain doesn't handle data ownership concerns normally. Businesses don't know how data and healthcare blockchain rules will interact.

Blockchain technology requires a solid infrastructure, connectivity, and professionals. Technical issues may hinder healthcare operations. Even while the idea of using blockchain in healthcare is incredibly exciting, it has not yet been put into practice in a good way. The health care business can't shift quickly because it's too fragile and broken apart. Because of this, it is hard to predict if this technology will be extensively used before it has been effectively tested by individuals in the company.

4.CONCLUSION

Blockchain has various advantages in this industry and may be used to solve several difficulties, such as exchanging records and keeping them safe. It claims to speed up a good shift by stimulating the invention of solutions that focus on the patient. Blockchain technology has made it feasible for many ground-breaking innovations. Blockchain technology should continue to aid healthcare

providers and customers since it can do rid of wasteful healthcare practices, ongoing data breaches, and rising hospital prices.

The healthcare business hasn't yet effectively dealt with the crucial components of blockchain technology, such mining incentives and specialized blockchain assaults that could wreck the whole process. As a result, these concerns will be resolved in the future.

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