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Decentralized of Health Care Management Using Blockchain

Naresh Thoutam, Associate Professor, Dept. of Computer Engineering, Sandip Institute of Technology and Research Centre, Nashik, Savitribai Phule Pune University, Maharashtra, naresh1060@gmail.com
Pramod Patil, Associate Professor, Dept. of Computer Engineering, Sandip Institute of Technology and Research Centre, Nashik, Savitribai Phule Pune University, Maharashtra, pgpatil11@gmail.com
Kiran Mahajan, Student of, Department Computer Engineering, Sandip Institute of Technology and Research Center Nashik, Savitribai Phule Pune University, Maharashtra, kiranmahajan2810@gmail.com
Karan Mahajan, Student of, Department Computer Engineering, Sandip Institute of Technology and Research Center Nashik, Savitribai Phule Pune University, Maharashtra, kvmahajan2002@gmail.com
Vivek Patil, Student of, Department Computer Engineering, Sandip Institute of Technology and Research Center Nashik, Savitribai Phule Pune University, Maharashtra, vp500973@gmail.com
Tejaswini Patil,Student of, Department Computer Engineering, Sandip Institute of Technology and Research Center Nashik, Savitribai Phule Pune University, Maharashtra, tejaswinip202@gmail.com

ABSTRACT: Electronic Health Records (EHRs) have become an integral part of modern healthcare systems, improving patient care, reducing administrative overhead, and enhancing medical research. However, concerns about data security, interoperability, and patient control over their health information persist. This paper proposes a decentralized approach to EHR management by leveraging blockchain technology to address these concerns. The paper discusses the potential impact of our decentralized EHR system on healthcare outcomes, patient engagement, and research advancements. It also highlights the challenges and limitations that need to be addressed for practical implementation. The proposed system has the potential to transform the healthcare industry, placing patients at the center of their health data management while ensuring the privacy and security of their sensitive information.

KEYWORDS: Decentralization, Electronic Health Record (EHR), Blockchain Technology, Health Data Security, Data Privacy, Patient-Controlled Access, Health Information Exchange, Smart Contracts, Transparency, Audit Trail, Healthcare Blockchain

1. Introduction

A. Title

Decentralized Electronic Health Record Using Blockchain.

B. Electronic Health Record

A decentralized electronic health record (EHR) system using blockchain technology is a revolutionary approach to managing and sharing healthcare data. Traditional EHR systems often suffer from issues related to data security, interoperability, and patient control. Blockchain technology offers a promising solution to address these challenges. In this system, patient health records are stored in a decentralized and immutable blockchain ledger. Each patient has control over their own health data and can grant permission to healthcare providers, researchers, or other authorized parties to access specific parts of their record. The blockchain ensures the integrity and security of the data, making it resistant to tampering or unauthorized access**.** *An Electronic Health Record (EHR) is an electronic version of a patient's medical history that is maintained by a*

hospital or other organization over time. It includes all key administrative clinical data relevant to the patient along with all previous reports, X-rays, laboratory data, prescriptions, and other forms of data describing past medical history

C. Key points

1. Healthcare Data Revolution: Traditional electronic health record (EHR) systems have faced challenges related to data security, interoperability, and patient control.
2. Blockchain Technology: Blockchain, initially developed for cryptocurrencies like Bitcoin, offers a secure and transparent platform for managing and sharing healthcare data.
3. Data Security: Decentralized EHRs are stored on a tamper-proof blockchain ledger, ensuring data integrity and resistance to unauthorized access.
4. Patient Control: Patients have complete ownership and control over their health data, granting access to authorized parties as needed, enhancing privacy and autonomy.
5. Smart Contracts: Smart contracts enable automated, secure data sharing, reducing administrative overhead and minimizing the risk of data breaches.
6. Interoperability: Blockchain EHR systems improve interoperability between different healthcare providers and systems, streamlining data exchange for a more patient-centered approach.
7. Enhanced Efficiency: The system offers a more efficient and secure approach to healthcare data management, benefiting patients, healthcare providers, and researchers.
8. Privacy and Accuracy: Blockchain ensures that patient data remains accurate and private, reducing the potential for errors and breaches.

D. Challenges

1. Data Privacy and Security**:** Maintaining the privacy and security of sensitive health information is paramount. However, blockchain's transparency can be a double-edged sword, making it crucial to design privacy-enhancing features and encryption mechanisms to protect patient data.
2. Regulatory Compliance**:** The healthcare sector is heavily regulated, with laws like HIPAA in the United States. Adhering to these regulations while using blockchain, which is often seen as a disruptive technology, requires careful consideration and may necessitate legal and regulatory changes.
3. Data Interoperability: Achieving seamless data exchange between different healthcare providers and systems is a longstanding issue. Blockchain can help, but only if there are standardized protocols and frameworks in place.
4. Patient Control and Consent**:** Blockchain's promise of giving patients control over their data is appealing, but implementing this in practice can be complex. Establishing protocols for patient consent and data access, as well as dealing with patients who may not be technologically savvy, is a challenge.
5. Scalability**:** Blockchain networks face scalability issues, which become even more significant in healthcare applications where vast amounts of data need to be processed and stored efficiently.

E. purpose

The purpose of an Electronic Health Record (EHR) is to efficiently and securely digitize and store a patient's medical information, making it readily accessible to authorized healthcare providers**.** Electronic Health Record (EHR) is to digitally capture, store, and manage a patient's comprehensive medical information in a secure and easily accessible format. EHRs convert paper-based health records, including medical history, diagnoses, medications, treatment plans, immunization dates, allergies, radiology images, and laboratory test results, into digital format

2. Literature Survey

According to [1] a gesture-based secure interaction system with smart home IoT health devices to support elderly people or people with special needs. The framework uses a decentralized blockchain consensus for storing the smart home IoT health data and user identities.

According to [2] a scheme to generate seed needed for key generation and a scheme to manage the public key using blockchain. First, is a random seed generation scheme needed for key generation? In

order to prevent the risk of a man-in-the-middle attack and reverse engineering, seeds are generated by using out-of-band communication and hardware variation.

According to [3] initially reviewed and identified the security and privacy issue that exists in IoT systems. Secondly, Blockchain technology provides some security solutions. The details analysis, including enabling technology and integration of IoT technologies, is explained.

According to [4] one such implementation experience for Smart Toll Transaction application in the domain of mobility. Our paper showcases a possible solution by leveraging negotiations, decision-making, and distributed learning capabilities at the device level using AI-enabled Multi-Agent Systems and real-time smart contracts between Cars and Tolls using Blockchain.

According to [5] a content selection algorithm of edge cache nodes. The algorithm adopts the Markov chain model, improves the utilization of cache space, and reduces the content transmission delay. The hierarchical caching strategy is adopted and

the secondary cache stores slides of content to expand the coverage of cached content and to reduce user waiting time.

According to [6] Based on a sharing economy, this framework allows energy trading between households, bringing flexibility and decreasing the dependency on energy providers. In parallel, the increasing adoption of electric vehicles and the development of vehicle-to-grid (V2G) technology open new ways to store, transport, and deliver renewable energy.

According to [7] introduce the concept of a decentralized gasified service exchange platform where the solution providers can dynamically offer and request services in an autonomous peer-to-peer fashion. Cost and decision to exchange services are set during operation time based on gasification policies according to business goal.

3. Algorithms

The algorithms are:

Algorithm 1:Hash Generation
input: data d, Output: Generated hash H according to given data Step 1: Input data as d Step 2: Apply SHA 256 from the SHA family Step 3: Current Hash= SHA256 (d) Step 4: Return Current Hash

Explanation: A cryptographic hash function is a crucial component of the algorithm. Commonly used hash functions in blockchain applications include SHA-256 (part of the SHA-2 family) and SHA-3. These functions produce a fixed-size output (e.g., 256 bits) from variable-size input data

Algorithm 2: Peer-to-Peer Verification

Input: User Transaction query, Current Node Chain C Node[chain], Other Remaining Nodes blockchain Node-Chain [Node id] [chain],
Output: Recover if any chain is invalid else execute the current query.
Step 1: User generates any transaction DDL, DML, or DCL query
Step 2: Get the current server blockchain
Chain ← C node[Chain] (6.1)
Step 3: For each
End for
Step 4: For each (read I into Node Chain)
If (!. Equals Node Chand a in[i] with (C chain))
Flag 1
Else Continue the Commit query
Step 5: if (Flag == 1)
Count = Similarly Nodes Blockchian ()
Step 6: Calculate the majority of the server Recover invalid blockchain from the specific node
Step 7: End if
End for
End for

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Explanation: Peer-to-peer verification algorithms in the context of Electronic Health Records (EHRs) using blockchain can help ensure the integrity of health data and give patients and healthcare providers confidence in the accuracy and security of the records. Peer- to-Peer Verification Algorithm Is used to communicate between each other in this project we use peer-to-peer verification algorithm is used to communicate between Admin, hospital, User, insurance Company. Using this Algorithm they are able to communicate between each other.
P2P network also used by hash generation algorithm and mining algorithm.

Algorithms 3: Mining Algorithm for valid hash creation
Input: Hash Validation Policy P [], Current Hash Values hash -Val Output: Valid hash Step 1: System generates the hash -Val for the I the transaction using Algorithm 1 Step 2: if (hash -Val. valid with P []) Valid hash Flag =1 Else Flag=0 Mine again randomly Step 3: Return valid hash when flag=1

Explanation: In a blockchain network, the process of creating valid hashes for new blocks typically involves a consensus mechanism that miners use to compete in solving a computational problem. However, when it comes to Electronic Health Records (EHRs) in healthcare blockchains, a more energy-efficient and privacy-preserving approach might be required due to the sensitivity and regulatory aspects of healthcare data.

4. System Design

In Fig.4.1 system design there are Four Modules User, Admin, Hospital, and Insurance Company and we use some Algorithms like Peer-to-peer verification, hash generation and mining, and Recover validation.

User Module: By login to the User page, he/she can see his entire hospital history and can get information related to all his treatments. You can find out all your past or current illnesses, prescriptions and all payment bills.

Admin Module: Admin has able see all modules information like User, Admin, Hospital, Insurance company. Admin can see all process that are going on and can also see any error that come and solve it. Hospital Module: Hospital can login in to his page and can see all information of patients. hospital can see patients all treatment information, his prescription, His bill receipts, and you can also see which patients have taken which insurance.

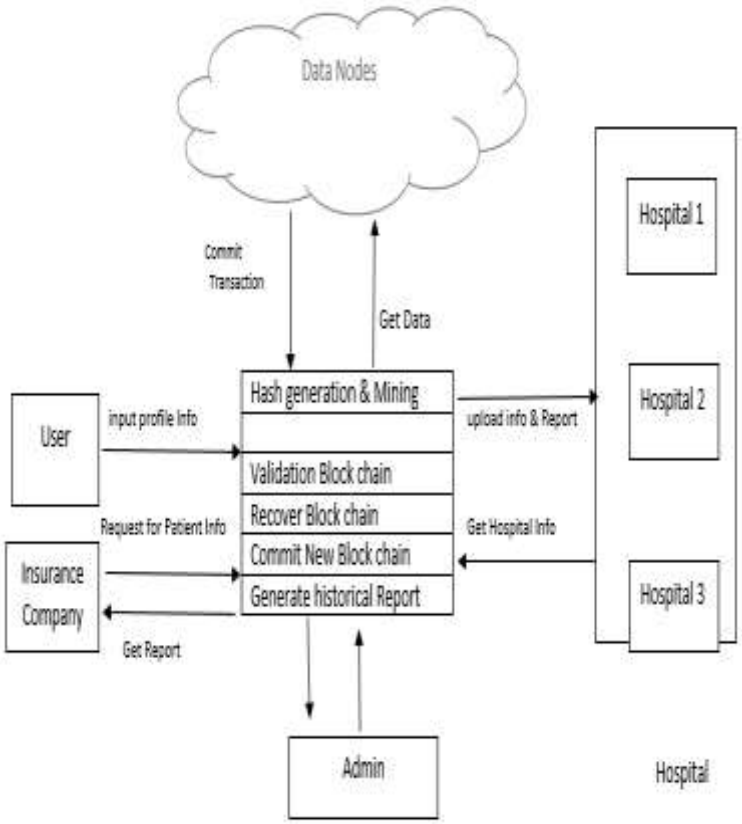

Fig.4. 1 System Architecture

1. Admin
2. Make a transaction
3. Block Generation and blockchain validation
4. Consensus Algorithm validation and blockchain recovery
5. Results Generation
6. The central outline of the proposed algorithm is the implementation of
7. supply chain management distribution data storage using blockchain.
8. System creates the trustworthy communication between multiple parties without using any third-party interface.
9. We use the Hash generation algorithm and the Hash will be generated for the given string.
10. Before executing any transaction, we use peer-to-peer verification to validate the data.
11. If any chain is in valid then it will recover or update the current server blockchain.
12. This will validate till all nodes are verified and commit the query.
13. A mining algorithm is used to check the hash generated for the query till the valid hash is generated start

5. H/W and S/W Requirement

A. H/W Requirement

Front End

1. Operating System: Windows XP/7/8
2. Programming Language: JAVA/J2EE/
3. Tools: Eclipse, Heidi SQL, JDK 1.7 or Higher
4. Database: MySQL 5.1

Back End

1 MySQL

B. H/W Requirement

1. Processor: Intel Pentium 4 or above
2. Memory: 2 GB or above
3. Other peripheral: Printer

6. Proposed Work

A proposed system for an electronic health record (EHR) aims to streamline the management of patient health information, enhance healthcare quality, and improve overall healthcare efficiency. electronic health record (EHR) system is designed to modernize and streamline healthcare data management. This system encompasses various key components and features, starting with capturing and maintaining patient demographics and health history. Clinical documentation is a central element, allowing healthcare providers to create and update records in a structured and standardized format. Medication management, allergy information, and integration of imaging and diagnostic reports are crucial for patient safety and treatment. Moreover, interoperability is essential, ensuring that healthcare systems can seamlessly exchange data while prioritizing privacy and security with robust access controls and encryption. Mobile access and telemedicine integration enhance the system's accessibility and usefulness. Decision support tools offer clinical guidance, while a patient portal empowers individuals to engage with their own health data. Data analytics, administrative functions, e-prescribing, and patient consent management are key for healthcare management, research, and compliance. Emergency access, audit trails, and scalability cater to diverse healthcare scenarios. With training, support, and a user-friendly interface, the proposed system aims to enhance healthcare efficiency and patient care, continuously adapting to meet evolving healthcare needs and regulatory requirements. all the participating nodes on the network i.e. hospitals, patients, Insurance agencies, etc. are required to be a part of two networks- the permissioned blockchain and IPFS. However, not all of them are not required to keep the entire
blockchain stored (light nodes).

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Health Record Structure:
Patient Id
Gender
Age
Disease
Diagnosis
Location
Medication
Suggestion
Next Review
Notes
Date
Doctor's Name
Hospital Id

Health Record Structure

IN fig.6.1 is a proposed description for each of these components:

1. Hospital Description
2. Laboratory Data Management System
3. Patient Diagram
4. Lab Test Results
5. Treatment Plan
6. Insurance plan

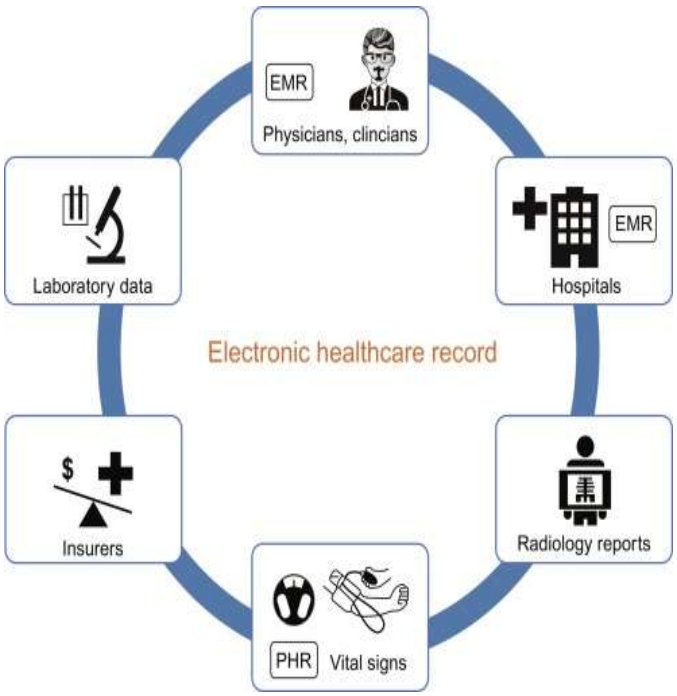


Fig.6.1 proposed model

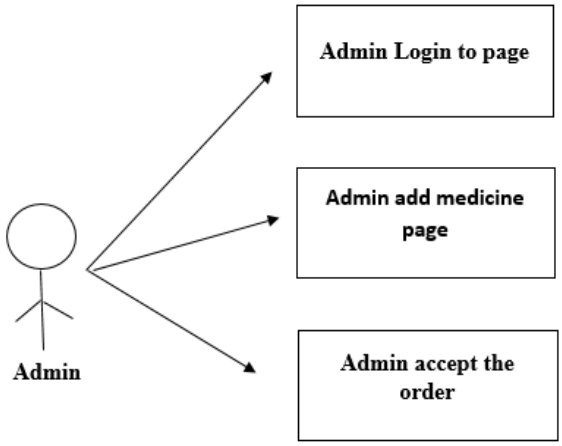
7. Module Split Up

The module can be split into three category

1. Admin
2. User
3. Distributer

Admin:

1) Admin login to the page
2) Admin add medicine Page
3) Admin accepts order page



User:

1) The user registers the page.
2) User login to the page.
3) The user orders the page.
4) Users order the next page.
5) The user's QR code is uploaded to the page.
6) The user saves the medicine on the page.

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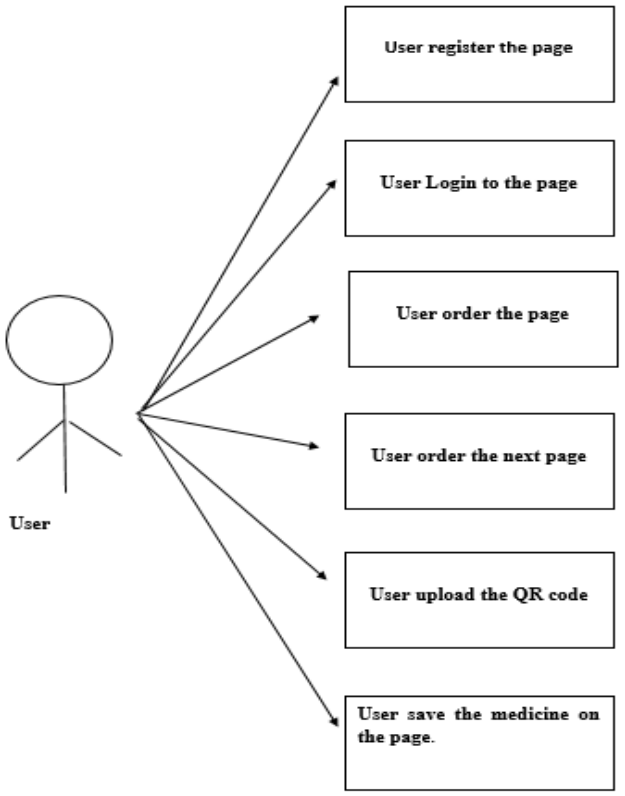

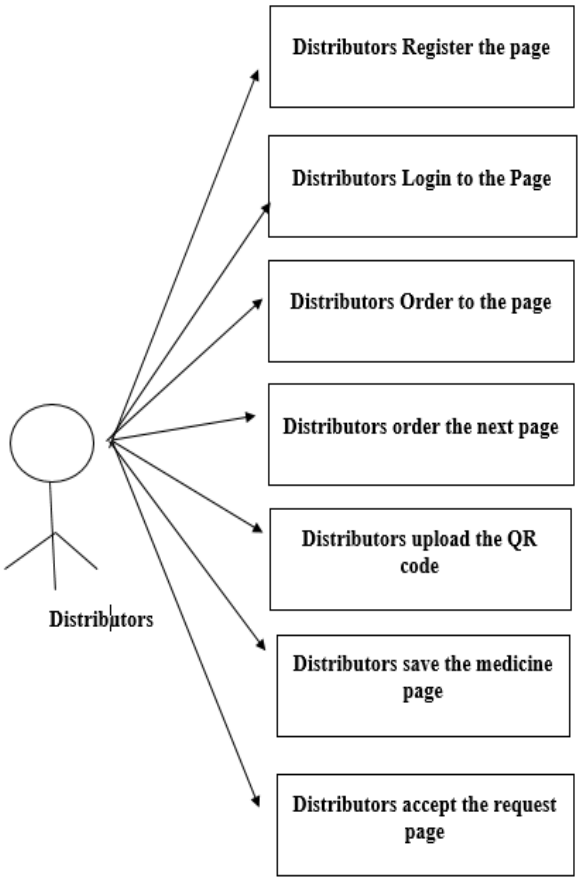

Distributor:

1) Distributors register the page.
2) Distributor login to the page.
3) Distributor order the page.
4) The distributor orders the next page.
5) Distributer QR code uploads the page.
6) The distributor saves the medicine on the page
7) The distributor accepts the request

8. Other Specification

A. Advantages

1. EHRs make patient information readily accessible to authorized healthcare providers, allowing them to quickly access and share critical patient data such as medical history, test results, and medications.

2. EHRs support better decision-making by providing real-time access to patient data. This can lead to more accurate diagnoses and treatment plans, ultimately improving patient care.

3. Electronic records streamline administrative tasks, reducing paperwork, and making it easier to manage appointments, billing, and insurance claims. This can result in time and cost savings for healthcare facilities.

4. EHRs can be designed to communicate and share data with other healthcare systems, enhancing coordination of care across different providers and healthcare settings. This interoperability is vital for modern healthcare networks.

5. HER is very useful because of this we don't need to carry his hospital treatment history.

B. Disadvantages

1. implementing an EHR system can be expensive, involving costs related to software, hardware, training, and data migration. Smaller healthcare practices, in particular, may find the upfront expenses burdensome.

2. Transitioning from paper-based records to EHRs can be challenging for healthcare providers and staff. Learning to use the system effectively may take time and result in a temporary decrease in productivity.

3. Inputting patient data into EHRs can be time-consuming, especially for healthcare providers who need to type or dictate information during patient visits. This can lead to longer appointment times and reduced face-to-face interaction with patients.

4. EHR implementation may disrupt existing workflows and require adjustments to accommodate the new system. This can lead to temporary inefficiencies and staff resistance

5. Some healthcare providers and patients argue that EHRs can lead to a loss of the personal touch in healthcare interactions, as providers may spend more time interacting with the computer than with patients

C. Applications

1. **Clinical Decision Support:** Provides alerts, reminders, and recommendations to aid in clinical decision-making.

2. **Prescription Management:** Facilitates electronic prescribing and checks for drug interactions.

3. **Billing and Coding:** Automates coding and billing processes for accurate reimbursement.

4. **Appointment Scheduling:** Helps patients book appointments and providers manage schedules.

9. Conclusion and Future Work

Conclusion

In conclusion, electronic health records (EHRs) have become integral to modern healthcare, offering numerous advantages while presenting certain challenges. They serve as a central hub for patient information, facilitating better patient care, clinical decision support, and efficient management of healthcare operations. EHRs enhance patient engagement, improve data security, and contribute to research and public health efforts. However, their implementation comes with an initial cost and a learning curve, and they can introduce new challenges related to data security, interoperability, and alert fatigue. Despite these challenges, EHRs have transformed healthcare by streamlining processes, improving information accessibility, and supporting quality care. To maximize the benefits of EHRs, healthcare organizations must carefully plan their implementation, provide adequate training, and address issues related to data security and privacy.

Future Work

To implement the proposed system on multiple peer to peer network, with fog computing which reduce the transactional data processing time

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