International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 04 | April - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

Blockchain Based MediChain System Connecting Pharma, Medicals and Patients Together

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ABSTRACT

In today's world almost all hospital uses hardcopy for patient data store and for booking appointment. All patient data is available on paper and user need to manage that all over he goes. Consider 'A' patient got admitted in City Pune, all his data is stored on paper and what medicines he took. All the info about his health is stored there. After someday 'A' patient gone to another city far away without carrying any documents and there he got and health emergency and is not in condition of speaking and need urgently help. But due to lack of info available about patient doctor could not urgently take decisions. So, to reduce this risk our system is developed. The distribution of Health records becomes a time consuming and expensive process when we use the traditional client-server healthcare data management system where each hospital/clinic maintains its own database of patients' medical records. A patient's treatment is further delayed if the patient moves from one hospital to another hospital across different regions or countries. Moreover, most of the time a patient must repeat several laboratory and radiology tests. So, to address this the patient's medical data from different hospitals are stored in a Blockchain based storage making it easily accessible by patients and the hospitals. And the pharma company will be able to store the information of medicines and medicals will be available to verify the medicines if they are from trustworthy companies.

Keyword - - Dapp, Web3.Js, CSS.

INTRODUCTION

Smart Health Care Dapp is made to connect hospitals, Patient, Medicals, and pharma company. As in today's world there are lot of misunderstandings between the doctors and patient and trust between them lacks. To develop trust between this entity smart health care Dapp will help. Whenever patient goes to the medicals to buy the medicines, he first think is the medicine provided by the medicals are good and not fake. Some medicals may keep fake medicines and expired medicines, these medicines may be provided to the patient. To avoid this, we can store all the medicines data on blockchain and track all process of medicines. And check if they came from trustworthy pharma company.

There are basically 4 clients included into this project such as Hospital, Medical, Pharma, and Patients. Our Decentralized Storage will have the detailed medical history of each patient. It will be stored with the help of blockchain. The data will be available to hospital as well as patients in the decrypted format for the future reference.

MOTIVATION

1.To help people get access to their health data anywhere from the world.
2.To provide trust between hospitals and the patients due to fake certificates by some doctors.
3.To Provide trust between medicals and the patient due to fake medicines seller.
4.To help people access their data in the emergency due to some accidents.
5.To improve the data storage of the patient health history and make it more secure using blockchain.

PROBLEM STATEMENT & OBJECTIVE

Blockchain Based Patients data , Medicines data and doctors data storage has novel features of real time accessing of all the data and keeping watch on it which enables users like patient and the medicals to keep track of all the data been stored on the blockchain using secure hash and access the data using unique keys thus data like Pharma Company medicine making process and the important dates are been stored and patient data like health history and the current medicines required by the patient which can be seen by only medicals and the patient are been stored and accessed in the emergency thus this enables a trust worthy environment between Hospitals, Patient, Medicals and Pharma Company.

Objective:

1. To store data of patients for doctor more secure and effectively.
2. To access data anywhere in the world whenever needed.
3. To keep track of patient health issues
4. To keep track of medicines which were provided by doctor.

PROJECT SCOPE & LIMITATIONS

Project Scope:

Secure and Private Data Sharing: With a blockchain-based Dapp, healthcare providers can securely and privately share patient data across different organizations, ensuring data privacy and confidentiality. This could help reduce data breaches, which are a significant problem in the healthcare industry.

Increased Efficiency: By using a Dapp, healthcare providers can automate administrative tasks, reduce paperwork, and streamline processes, resulting in increased efficiency and improved patient care.

Improved Patient Outcomes: With secure and fast access to patient data, healthcare providers can make more informed decisions and provide better care to patients, resulting in improved patient outcomes.

Transparency: Blockchain technology allows for transparent and immutable record-keeping, ensuring that all stakeholders have access to accurate and up-to-date information.

Tokenization: A blockchain-based Dapp could use tokens to incentivize patients and healthcare providers to participate in the network. For example, patients could earn tokens for sharing their data, while healthcare providers could earn tokens for providing quality care.

Limitations:

Limited Scalability: Blockchain technology can be slow and limited in its scalability, which could be a significant limitation for a SMART healthcare Dapp. As the number of users and transactions increases, the blockchain could become congested, leading to slower transaction times and higher fees.

Regulatory Challenges: Healthcare is a heavily regulated industry, and implementing a blockchain-based Dapp could pose significant regulatory challenges. Compliance with HIPAA regulations and other data privacy laws would need to be carefully considered.

Integration with Existing Systems: Integrating a new blockchain-based Dapp with existing healthcare systems could be challenging, as many healthcare organizations use legacy systems that may not be compatible with blockchain technology.

Limited Scalability: Blockchain technology can be slow and limited in its scalability, which could be a significant limitation for a SMART healthcare Dapp. As the number of users and transactions increases, the blockchain could become congested, leading to slower transaction times and higher fees.

METHODOLOGIES & PROBLEM SOLVING

1. Design thinking: This methodology involves understanding the needs of the users and designing solutions that meet those needs. It involves empathizing with the patients, doctors, and healthcare providers to identify their main points and then ideating, prototyping, and testing solutions that solve problems.

2. Agile methodology: This methodology involves breaking down the project into smaller, manageable tasks.

LITERATURE SERVEY

[1]. Israa Abu-elezz, Asma Hassan, Anjanarani Nazeemudeen, Mowafa Househ, Alaa Abd alrazaq, The benefits and threats of blockchain technologyin healthcare: A scoping review, International Journal of Medical Informatics, Volume 142,2020, 104246, ISSN 1386-5056

In this paper the author summarizes about all the perspectives about the Blockchain in Healthcare domain. The objective of this paper is to categorize the benefits and threat of blockchain technology application in healthcare. It states that Blockchain is a viable technology that helps in data sharing and storing system owing to its decentralization, immutability, transparency, and traceability features.

[2]. L. Soltanisehat, R. Alizadeh, H. Hao and K. -K. R. Choo, "Technical, Temporal, and Spatial Research Challenges and Opportunities in Blockchain-Based Healthcare: A Systematic Literature Review," in IEEE Transactions on Engineering Management.

Discusses how Blockchain can be used to build a peer-to-peer, secure, and smart transactionsystem especially for the development of healthcare system. Currently the world trends have shifted from patient/health centred to eHealth centred. The Existing healthcare systems face challenges such as interoperability, delays in process and diagnosis, delays in sharing information, the high cost of operation and processes, time- consuming insurance processes and costs, privacy, security, data ownership, and control.

[3]. L. Ismail, H. Materwala and S. Zeadally, Lightweight Blockchain for Healthcare, in IEEE Access, vol. 7, pp. 149935-149951, 2019.

The enormous potential for healthcare data management to deliver more precise and economical patient care has attracted a lot of attention in recent years. Single point of failure, data privacy, centralized data stewardship, system vulnerability, and traditional client-server and cloud-based healthcare data management systems are all problems. Blockchains replication mechanism, privacy, and security features have a bright future in the healthcare industry since they can address several problems with the health management system.

[4]. B. Alamri, K. Crowley and I. Richardson, Blockchain-Based Identity Management Systems in Health IoT: A Systematic Review, in IEEE Access, vol. 10, pp. 59612-59629,2022

Any information system, including healthcare information systems, needs Identity and Access Management (IAM) solutions. Due to the amount and sensitivity of health data, attackers target health IoT (HIoT) applications. IAM systems for HIoT must be created using strict guidelines and solid frameworks. A popular emerging technology for creating decentralized IAM solutions is blockchain (BC).

PROPOSED METHODOLOGY

Blockchain Architecture:

Smart Contracts: Utilize Solidity, a programming language specifically designed for creating smart contracts on the Ethereum blockchain. Smart contracts will be responsible for managing the storage and access control of patients' data, medicines data, and doctors' data.

Decentralized Storage: Leverage the decentralized nature of blockchain to store data across multiple nodes, ensuring transparency, immutability, and security.

Data Structure:

Patient Data: Include essential information such as medical history, prescriptions, allergies, and personal details. Ensure encryption and permission-based access for privacy.

Medicines Data: Store details about medicines, including composition, usage instructions, and potential side effects. Enable easy traceability for quality control.

Doctors' Data: Capture credentials, specialization, and

professional history. Implement access controls to protect sensitive information.

User Authentication and Authorization:
Web Application: Develop the user interface using React.js, providing a seamless experience for users to interact with the blockchain. Implement a secure authentication system to verify and grant access to authorized users.
Access Control: Smart contracts will enforce access control, allowing only authorized entities (patients, doctors, and administrators) to interact with and modify specific data.

Interfacing with Blockchain:
Web3.js Integration: Connect the React.js application with the Ethereum blockchain using Web3.js library. This facilitates communication between the front-end and the smart contracts.
User Wallets: Enable users to interact with the blockchain using their Ethereum wallets. This ensures secure transactions and data access.

Smart Contract Development:
Remix IDE: Utilize Remix IDE for smart contract development and testing. Remix provides a user-friendly environment for coding, debugging, and deploying smart contracts on the Ethereum blockchain.
Contract Functions: Implement functions within smart contracts to handle data storage, retrieval, and modification. Ensure the security of these functions to prevent unauthorized access.
The goal of this system is to transmit sensitive information covertly, using the cover image as a disguise. Steganography techniques aim to hide the existence of the secret message, making it difficult for unauthorized parties to detect or decipher the hidden data. However, it's important to note that the effectiveness of steganography depends on the chosen algorithms and the ability to resist various forms of analysis.

BLOCK DIAGRAM

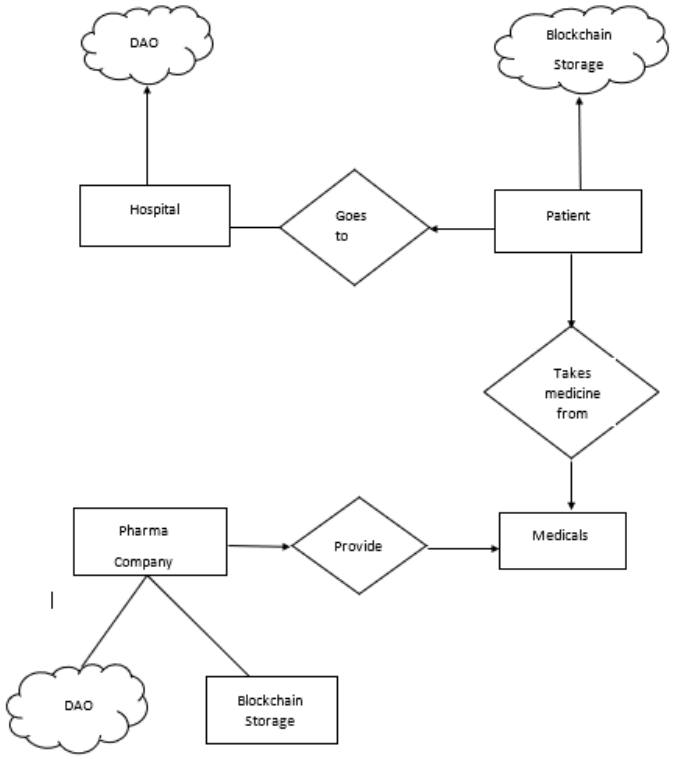


Figure 4.1: Block Diagram

As shown in above figure 4.1 block diagram shows the system flow of smart healthcare dapp project. Namely it consist of four main modules like Hospital, patient, medicals and pharma company. System is developed in blockchain technology so it is completely decentralized means there is no central authority. And completely secure. Which is mainly useful to store the patient details securely.

APPLICATIONS

1. Can be used in Hospitals.
2. Can be used in Medicals.
3. Can be used by patients for verifying and storing their medical data.
4. Can be used for storing medicines whole data.

HARDWARE AND SOFTWARE REQUIREMENTS

Hardware Requirements

1. Processor - Intel I5 core

2. Speed - 3.20 GHz RAM - 8 GB (min)
3. Hard Disk - 400GB
4. Display Screen

Software Interfaces

For software interface we have used Visual Code. It supports all the libraries related to React.

ANALYSIS MODEL: SDLC MODEL

The SDLC model that we have applied while working on this project is the incremental model.

1.Requirement gathering & analysis: In this phase, requirements are gathered from customers and checked by the analyst, to ensure if the requirements can be fulfilled or not. Analyst checks the need will achieve within budget or not.

2.Design: In the design phase, the design team designs different diagrams like Data Flow diagram, use case diagram, activity diagram, class diagram, state transition diagram, etc.

3.Implementation: In this phase, the requirements are coded using suitable language and transformed into computer programs which are called Software.

4.Testing: After completing the implementation phase, the software is tested using different test methods and testing tools. The methods like white box, black box, and gray box testing methods are used.

5.Deployment: After completing all the above phases, the software is deployed.

6.Review: In the review phase, after the software deployment, the behavior and validity of the developed product are checked. And if any error is found then, the SDLC process starts again from the first phase.

7.**Maintenance:** In this phase, after deployment of the software in the working environment there may raise a few bugs, or errors. Also, the customer may require new updates to the product.

MATHEMATICAL MODEL

What Is a Merkle Tree?

1.Merkle trees, also known as Binary hash trees, are a prevalent sort of data structure in computer science.
2.In bitcoin and other cryptocurrencies, they're used to encrypt blockchain data more efficiently and securely.
3.It's a mathematical data structure made up of hashes of various data blocks that summarize all the transactions in a block.
3.It also enables quick and secure content verification across big datasets and verifies the consistency and content of the data.

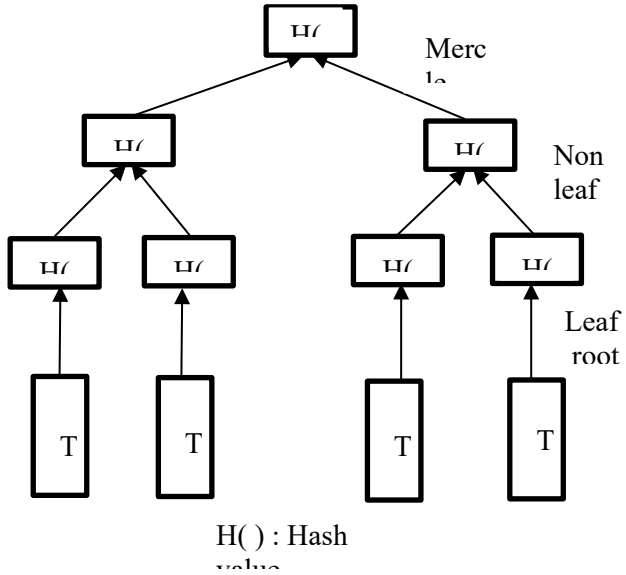


Figure 4.2.1 Merkle Tree

DATA FLOW DIAGRAM: As shown is above figure 4.3.1 DFD level 0 which is a data flow diagram of level 0 which shows us the basic overview of the whole system for analyzing purpose. Smart healthcare dapp consist of four modules like hospital, patient, medicine, pharma company. These modules are closely interlinked with each other to store the data securely.

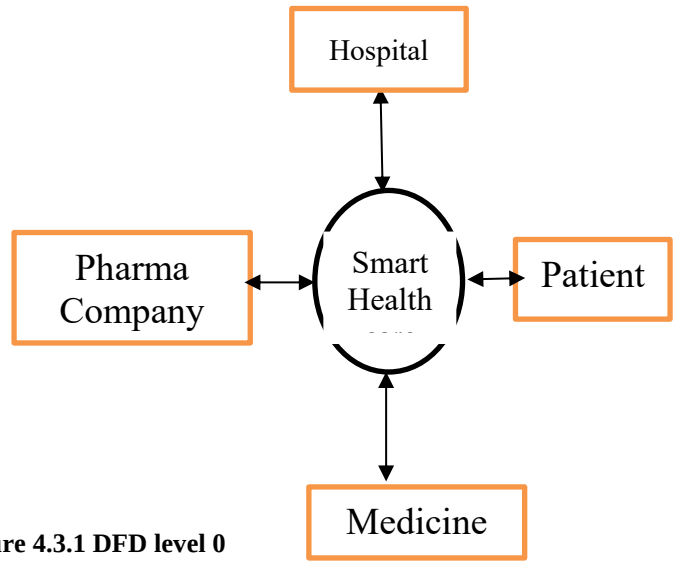


Figure 4.3.1 DFD level 0

STATE CHART DIAGRAM

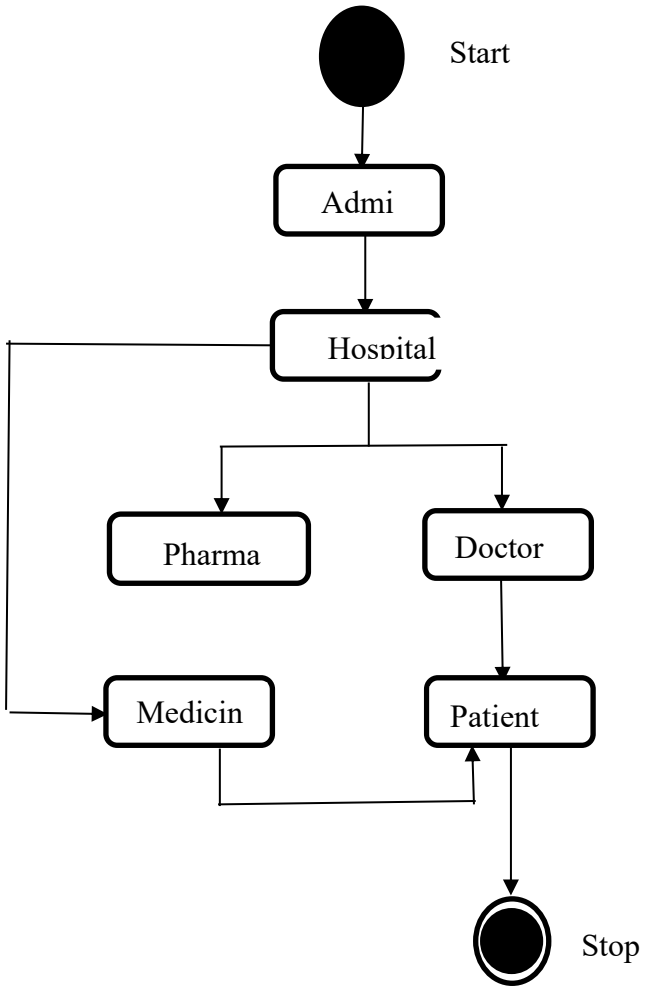


Figure 4.4.3 State chart Diagram

As shown in above figure 4.4.3 State chart diagram shows the abstract description of the behavior of the system. As shown in above diagram different modules are there. they show the analytical behavior of the system.

PROJECT RESOURCES

1.Project Manager: A project manager is responsible for overseeing the entire project, ensuring that it is delivered on time, within budget, and meets the quality standards. The project manager should have experience in managing software development projects and knowledge of blockchain technology.

2.Blockchain Developer: A blockchain developer is responsible for developing and implementing the blockchain technology, such as creating smart contracts and integrating them into the system. The developer should have experience in blockchain development, cryptography, and smart contract programming.

3.Front-end Developer: A front-end developer is responsible for developing the user interface and user experience of the DApp. The developer should have experience in HTML, CSS, JavaScript, and front-end frameworks such as React or Angular.

4.Back-end Developer: A back-end developer is responsible for developing the server-side of the DApp. The developer should have experience in programming languages such as Java, Python, or Node.js, and knowledge of server-side frameworks such as Express or Spring.

5.Quality Assurance Engineer: A quality assurance engineer is responsible for testing the DApp for functionality, security, and performance. The engineer should have experience in software testing, knowledge of testing frameworks such as Selenium or Appium, and knowledge of security testing techniques.

6.Security Engineer: A security engineer is responsible for ensuring the security of the DApp, such as implementing encryption, access control, and secure communication protocols. The engineer should

have experience in cybersecurity, cryptography, and knowledge of security frameworks such as OWASP.

7.Technical Writer: A technical writer is responsible for creating the documentation for the DApp, such as user manuals, developer guides, and API documentation.

RESULTS

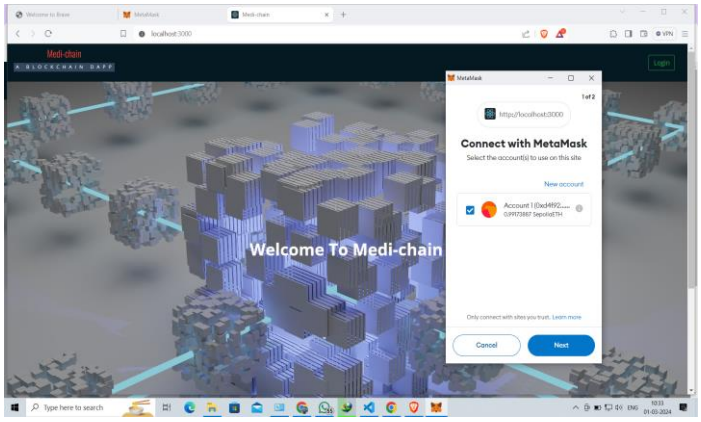


Fig.01 user interface

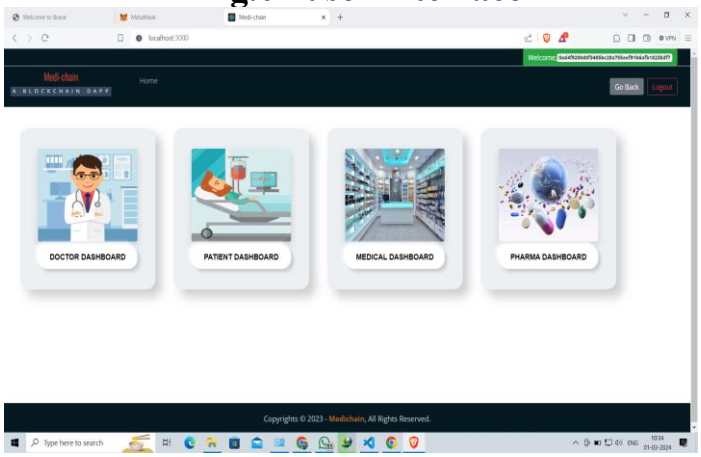


Fig.02 Dashboard

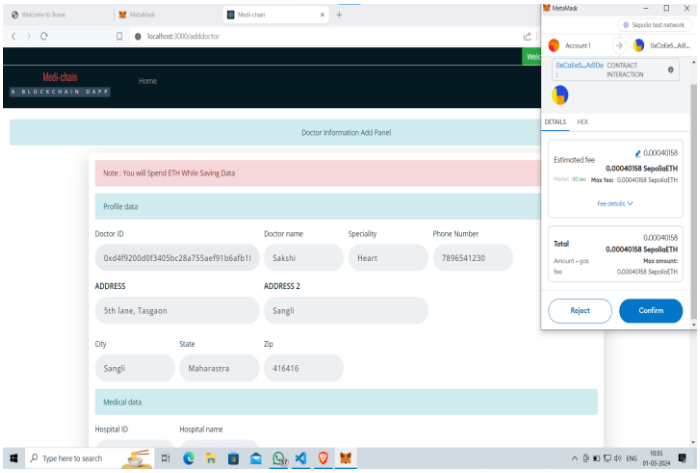
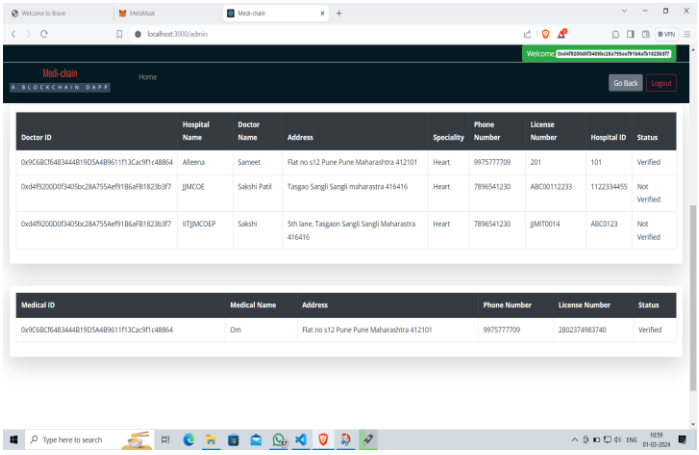


Fig.03 Adding Doctors



CONCLUSION

Healthcare data management has been gaining increasing attention in the last few years as it can provide more accurate, efficient, and cost-effective patient care. Blockchain technology has strong potential to improve the management of medical data because it can address issues such as single point of failure, data stewardship, system vulnerability, distributed information, and high security and privacy risks prevailing in the existing client-server and cloud-based approaches. However, most of the recent research efforts aimed at implementing blockchain in the healthcare domain have focused on the Bitcoin network. However, as we have mentioned previously, the Bitcoin network suffers from high energy

consumption, low transaction throughput, limited scalability, and privacy and security threats. Consequently, there is a need for a more scalable and efficient blockchain architecture. In this paper, we have proposed a fast way blockchain architecture for healthcare data management that has low computational, and communication overhead as compared to the Bitcoin network. We replaced the energy consuming mining consensus protocol of the Bitcoin network with a scalable and an energy-efficient consensus protocol.

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