

A Blockchain-Enabled Key-Value Storage System for an Electronic Medical Record Database System

¹ Dr. S. Geetha, CMR Institute of Technology, geetha2016research@gmail.com

Received: 29 December 2021 / Accepted: 28 January 2022

© The Author(s) 2022

Abstract:

Smart technologies in Healthcare exhibit a significant advancement to ease the storage of patient's medical records to enable an accurate flawless database system. Not only a patient report must be recorded with the previous report in a health care unit, but also should be accessible by the general practitioner and the patient using smart devices and systems. To make the data sharing immutable, robust, decentralize, and secure, blockchain technology is deployed in the database storage system. With the aid of IoT devices and sensors, a block with new medical records of the patients is created by the health care laboratory clinical technicians in the blockchain database system. A huge volume of data is stored by deploying a cloud via a gateway interface that connects to smart devices of the patient and related medical healthcare provider systems in a peer-to-peer network. After authorization, the new medical record is attached to the database system which has the existing medical record of the patient. This offers transparency and privacy to the electronically linked blocks of the patient record.

Keywords— Medical Record, Key, Sensor, IoT

1. Introduction

Real-time filing of patients' medical record is a challenging task when the number of patients make multiple visits with health complications in a hospital as there is a need to observe health status and record health care services provided each time. In multiple visits, some information may be replicated again and again. So, a database storage system is required to store the patient information, health status, and the health care services to make ease of the storage and retrieval avoiding replication.

The day-to-day information regarding the patient has to be recorded with a long-time information storage system. The long-term storage of the information helps the medical practitioner to retrieve the history of the health status of the patient and also the health service that was provided earlier to make a clinical analysis.

The database also adds its favor in administrative analysis related to patient details, transactions made before, feedbacks, legal requirements, etc. with security and privacy.

To handle massive health care information, it deploys IoT based electronic medical record database system with blockchain technology. This allows the systematic storage of huge data shared among different health care unit laboratory and clinical technicians.

As smart devices and sensors are needed for electronic recording, a smart energy grid network interface with the internet of things provides decentralization in blockchain database storage systems. It also provides a collection of data to generate a better controlling system in a wireless machine-to-machine environment. The main focus is information storage, sharing, and retrieval.

The main features of blockchain in data sharing with IoT environment are immutability, robustness, decentralization, and secure privacy. In the blockchain mechanism, a new medical record of the patient is created by the health care laboratory clinical technician. Details of the patient, health observation, administrative details, etc. are considered as additional data that need to be exchanged or linked. It is done through a hash pointer linking data structure.

A huge volume of data is stored by deploying a cloud via a gateway interface that connects to smart devices of the patient and related medical healthcare provider systems in a peer-to-peer network. After authorization, the new medical record is attached to the database system which has the existing medical record of the patient. It also involves a process of mining to order the data in the database storage system.

Decentralization and mining decrease the sharing and the retrieval delay of patient records under critical analysis. Not only the information is shared in smart systems and in different clinical systems but also to the patient itself and their related person who make use of

IoT enabled smart devices linked with the storage system.

The blockchain has fault tolerance and if two blockchains have the same length, it selects the chain that is most recent. It blocks the non-trusted users from accessing the electronic patient record.

The linking of different blocks from numerous devices using blockchain technology offers transparency and privacy to the electronically linked blocks of the patient record.

2. Materials and Methods

- The first objective is to collect the patient details & health records using IoT sensors and smart devices and generate a block.
- The second objective is to store the information in a cloud via a gateway.
- The third objective is to deploy a blockchain by linking the new medical record to the existing medical record of the patient in the database system after authorization.

To make the data sharing in a medical environment decentralize and secure, blockchain technology is deployed in the database storage system. The patient details and health reports collected at first is stored in the database system. Next, the patient health records that are collected using IoT devices and sensors at multiple visits are created as a block. As the patients and their records are in huge volume, they are stored in a cloud via the gateway. The blockchain technology is deployed in the medical database system allows a peer-to-peer network performing a blockchain by linking the new record with the already existing record after the authorization. The data is ordered by mining in the database system which also enables easy access for sharing and retrieving the data without delay for clinical and administrative analysis. The data can be shared or retrieved from smart devices and systems equipped in a clinical environment for the medical practitioner to access or the patient itself or the person related to the patient.

Summary of the Invention

To meet the need for secure and decentralize database sharing in the internet of things environment, blockchain technology is deployed. A block of the patient record is initially created individually. Every time the patient visits the hospital, meets the general practitioner, and gets services along with checkups. The patient's health status is gathered using IoT devices and sensors at multiple visits and is created as

a separate block along with the name of the department visited, name of the Doctor attended, treatment carried out, medicines prescribed, timestamp etc. has to be recorded at each visit. As the number of patient visits and their records is in huge volume, they are needed to be stored in a cloud platform via a gateway. The blockchain technology is deployed in the medical database system allows a peer-to-peer network performing a blockchain by linking the new record with the already existing record after the authorization in a hash data structure. The data is ordered by mining in the database system which also enables easy access for sharing, editing, and retrieving the data without delay for clinical and administrative analysis. The data can be shared or retrieved using smart devices and systems equipped in a medical environment for the clinical practitioner to access or the patient itself or the person related to the patient anytime when needed. The performance of the blockchain in data sharing with IoT environment exhibits immutability, robustness, decentralization, and secure privacy.

Detailed Description of the Invention

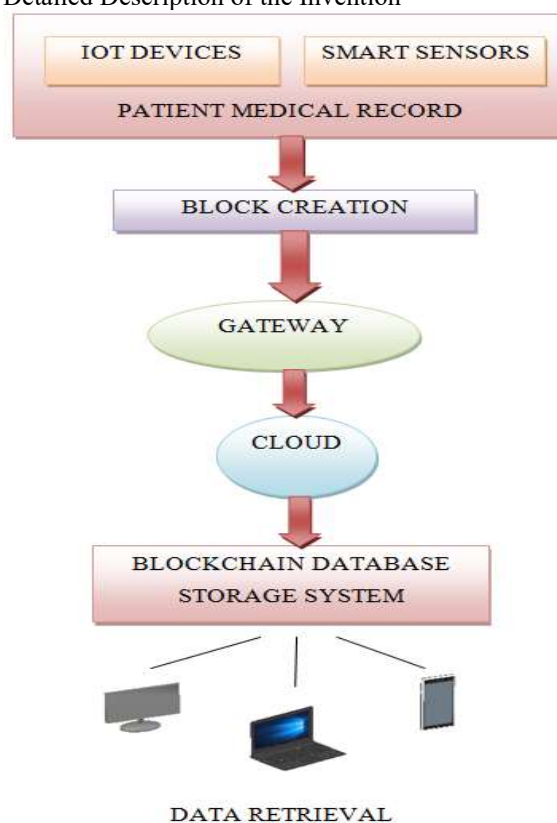


Fig. 1 illustrates the process flow diagram of an electronic medical record database system using blockchain-enabled key-value storage system.

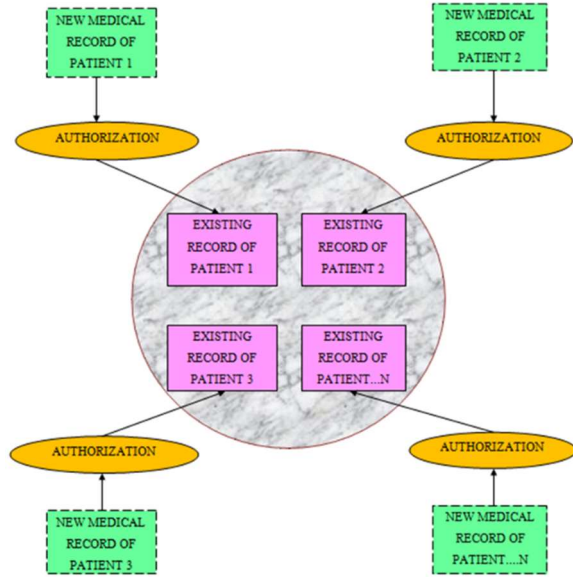


Fig. 2 illustrates the blocks added in blockchain technology.

Detailed Description of the Invention

Fig.1 illustrates the process flow diagram in storing the medical record of the patient in the medical environment and the retrieval of the information from the database storage system. The most vital field that needs technological advancement is the medical environment. As there are many infections and problems that occur frequently in human beings causing multiple defects, it makes the patient visit hospital often. There is also a need to take regular checkups every few months and have to be updated which will be a record in critical analysis. In hospitals, day to day information regarding the patient also needs to be recorded with a long-time information storage system. The long term storage of the information helps the medical practitioner to retrieve the history of the health status of the patient and also the health service that was provided earlier to make a clinical analysis. A database is needed that can make the storage and retrieval easier. The database not only has patient medical records but also adds its favor in administrative analysis related to patient details, transactions made before, feedbacks, legal requirements, etc. with security and privacy. To handle massive health care information in the medical environment, it deploys IoT based electronic medical record database system with blockchain technology. This allows the systematic storage of massive data shared among different health care unit laboratory and clinical technicians avoiding replication. Blockchain technology provides a secure and decentralized database sharing in the internet of things environment. A block of the patient record is initially created

individually. Every time the patient visits the hospital, meets the general practitioner, and gets services along with checkups. The patient's health status is gathered using IoT devices and sensors at multiple visits and is created as a separate block along with the health status, the name of the department visited, name of the Doctor attended, treatment carried out, medicines prescribed, timestamp etc. has to be recorded at each visit. As the number of patient visits and their records is in huge volume, they are a need to store the record in a cloud platform via a gateway interface. The blockchain technology deployed in the medical database system allows a peer-to-peer network performing a blockchain by linking the new record with the already existing record after the authorization in a hash data structure. The data is ordered by mining in the database system which also enables easy access for sharing, editing, and retrieving the data without delay for clinical and administrative analysis. The data can be shared or retrieved using smart devices and systems equipped in a medical environment for the clinical practitioner to access for making analysis in examining the patient. The records are also accessible to the patient itself and the person related to the patient anytime whenever needed. The performance of the blockchain in data sharing with IoT environment exhibits immutability, robustness, decentralization, and secure privacy.

Fig.2 illustrates the blockchain technology. It has no centralized block and has fault tolerance. There is no fault at a single point as the design is a peer-to-peer network. Each and every patient record is stored in the database. As the new record are observed, they are authorized with the hash data structure, ordered, and added to the existing block. This enables transparent data sharing in the medical environment that can be retrieved at a critical moment in the analysis of the patient.

3. Conclusion

Wireless internet of things enabled smart devices and sensors deployed to capture health metrics and the details of the patient. High speed wireless internet connection deployed in the electronic medical record. Highly configured computer systems deployed to handle the reports of a health care unit. The medical records are stored in the cloud via gateway. Blockchain technology deployed to add the new record to existing record in blocks after authorization. Smart display devices or systems deployed to retrieve the information from the clinical environment database system.

References

1. Wikipedia. Blockchain [Internet] [place unknown]: Wikimedia Foundation; c2019.
2. Wikipedia. InterPlanetary File System [Internet] [place unknown]: Wikimedia Foundation; c2019.
4. Deloitte. Blockchain: opportunities for health care [Internet] New York (NY): Deloitte; c2019.
5. Gordon WJ, Catalini C. Blockchain technology for healthcare: facilitating the transition to patient-driven interoperability. *Comput Struct Biotechnol J*. 2018;16:224–230.
6. Kuo TT, Kim HE, Ohno-Machado L. Blockchain distributed ledger technologies for biomedical and health care applications. *J Am Med Inform Assoc*. 2017;24:1211–1220.
7. Cyran MA. Blockchain as a foundation for sharing healthcare data. *Blockchain Healthc Today*. 2018;1:13