

# Electronic Health Record Management Using Blockchain Approach

M.Samba SivaRao , B.Pujitha , B.Hemanth , K.Jayasree

**Abstract :** Blockchain have been an interesting research area for a long time and the benefits it provides have been used by a number of various industries. Similarly, the healthcare sector stands to benefit immensely from the blockchain technology due to security, privacy, confidentiality and decentralization. Nevertheless, the Electronic Health Record (EHR) systems face problems regarding data security, integrity and management. In this paper, we discuss how the blockchain technology can be used to transform the EHR systems and could be a solution of these issues. We present a framework that could be used for the implementation of blockchain technology in healthcare sector for EHR. The aim of our proposed framework is firstly to implement blockchain technology for EHR and secondly to provide secure storage of electronic records by defining granular access rules for the users of the proposed framework. Moreover, this framework also discusses the scalability problem faced by the blockchain technology in general via use of chain storage of the records. This framework provides the EHR system with the benefits of having a scalable, secure and integral blockchain -based solution

**Keywords:** Block Chain, Distributed Systems, Electronic Health Records, Medical Informatics

\* Correspondence Author

**Mr.M.SambaSivaRao**, Associate professor, *Department of CSE,*  
*Usha Rama College of Engineering and Technology,*  
*India,*

Email:sambamarrapu@gmail.com

**B.Pujitha**, *Department of CSE,*  
*Usha Rama College of Engineering and Technology,*  
*India.*

Email:pujithabhupathiraju212@gmail.com

**B.Hemanth**, *Department of CSE,*  
*Usha Rama College of Engineering and Technology,*  
*India.*

Email:b.hemanthavg@gmail.com

**K.Jayasree**, *Department of CSE,*  
*Usha Rama College of Engineering and Technology,*  
*India.*

Email:jayasreekurra010@gmail.com

## 1. INTRODUCTION

The recent advent in technology is affecting all parts of human life and is changing the way we use and perceive things previously. Just like the changes technology has offered in various other sectors of life, it is also finding new ways for improvement in healthcare sector. The main benefits that advancement in technology is offering are to improve security, user experience and other aspects of healthcare sector. These benefits were offered by Electronic Health Record (EHR) and Electronic Medical Record (EMR) systems. However, they still face some issues regarding the security of medical records, user ownership of data, data integrity etc. The solution to these issues could be the use of a novel technology, i.e., Blockchain. This technology offers to provide a secure, temper-proof platform for storing medical records and other healthcare related information. Before the advent of modern technology, healthcare sector used paper based system to store the medical records, i.e., using handwritten mechanism.

This paper-based medical record system was inefficient, insecure, unorganized and was not temper-proof. It also faced the issue of data- duplication and redundancy as all the institutions that patient visited had various copies of patients medical records. The healthcare sector faced a trend shift towards EHR systems that were designed to combine paper-based and electronic medical records (EMR). These systems were used to store clinical notes and laboratory results in its multiple components. They were proposed to enhance the safety aspect of the patients by preventing errors and increasing information access. The goal of EHR systems was to solve the problems faced by the paper-based healthcare records and to provide an efficient system that would transform the state of healthcare sector. The EHR systems have been implemented in a number of hospitals around the world due the benefits it provides, mainly the improvement in security and its cost-effectiveness. They are considered a vital part of healthcare sector as it provides much functionality to the healthcare. These functionalities are electronic storage of medical records, patients appointment management, billing and accounts, and lab tests. They are available in many of the EHR system being used in the healthcare sector. The basic focus is to provide secure, temper-proof, and shareable medical records across different platforms. Despite the fact that notion behind usage of EHR systems in the hospitals or healthcare was to improve the quality of healthcare, these systems faced certain problems and didn't meet the expectations associated with them. A study was conducted in Finland to find the experiences of nursing staff with the EHR, it was concluded that EHR systems faced the problems related to them being unreliable and having a poor state of userfriendliness. The EHR system also faces some other problems which are as follows: Interoperability: It is the way for different information systems to exchange information between them. The information should be exchangeable and must be usable for further purposes. An important aspect of EHR systems is its Health Information Exchange (HIE) or in general data sharing aspect. Today the greatest problem in healthcare sector defined by the critics is information asymmetry which refers to one party having better access to information than the other makes it party. In case of EHR systems or in general healthcare sector is suffering from this problem as doctors or hospitals have access to the patient's records, thus making it central. If a patient wants to access his medical records he would have to follow a long and tedious process to access them. The information is centralized to only a single healthcare organization and its control is only provided to the hospitals or organizations. Data Breaches: Data breaches in healthcare sector also calls for the need of a better platform. A study was done for analyzing the data breaches in EHR systems and it depicted that 173 million data entries have been compromised in these systems since October 2009. Another study conducted by Argaw et al. explains that hospitals have become a target of cyber-attacks and an increasing trend has been witnessed by the researchers while conducting this study that a lot of research work has been done in this domain. Moreover, many EHR systems are not designed to fulfill the needs and requirements of the patients and face the issues related to inefficiency and poor adaptation of these systems. The literature also suggests that use of EHRs have introduced negative consequences to information processing. These problems make it reasonable to find a platform that would be helpful in transforming healthcare sector to be patient-centered, i.e., Blockchain. A platform which is secure, transparent and it also provides data integrity to the medical records of the patients. This paper proposes a framework that creates such a decentralized platform that would store patient's medical records and give access of those records to providers or concerned individuals, i.e., patient. We also intend to solve the scalability problem of blockchain, as it is not in the design of blockchain to store huge volumes of data on it. So, we would use off-chain scaling method that makes use of the underlying medium to solve the scalability problem by storing the data on that medium. Moreover, our proposed work is intending to solve the above mentioned information asymmetry and data breaches problem faced by the EHR system.

## 2.DESIGN

The proposed framework consists of users that could be patients, doctors and Insurance Agent. They were given granular access as they should have varying level of authority on the system.

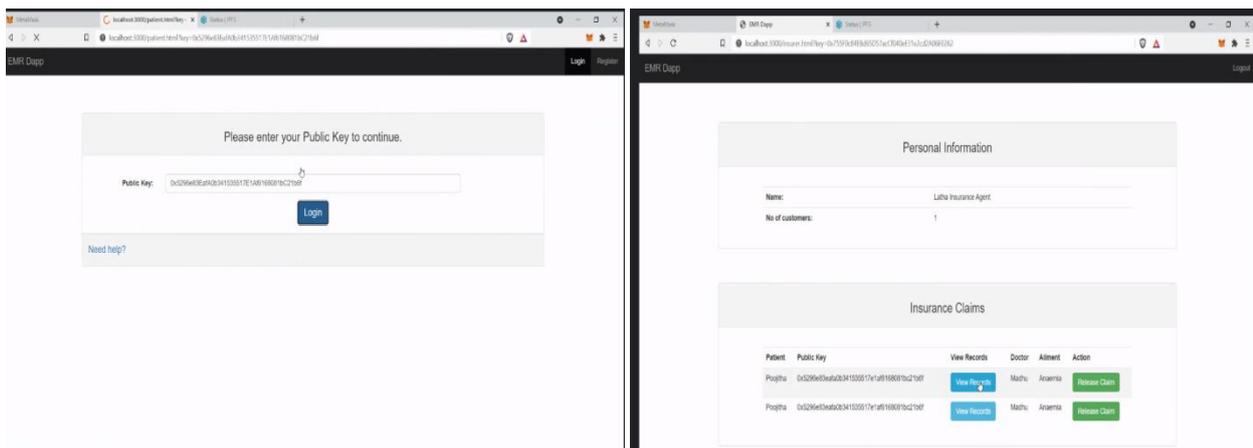
**1) USER LAYER** A user of a system is defined as an individual who makes effective use of the system and its resources. A user has various roles and features on the system, making him identifiable on the system. The users of this system could be patients, doctors and administrative staff etc. The main task of these users would be to interact with the system and perform basic tasks such as create, read, update and delete the medical records. The users using this system would be accessing the system's functionality by a browser which in technical terms we refer as DApp browser, as it is containing the GUI (Graphical

User Interface) of the DApp, i.e., our proposed system framework. The GUI contains all the functions that could be accessed by a particular user. The user according to the assigned role could use this GUI for interacting with the other layer of the system, i.e., blockchain layer .

**2) BLOCKCHAIN LAYER** The next layer on the system is the blockchain layer; this layer contains the code or mechanism for interaction of user with the DApp which is functioning on the blockchain. **TRANSACTIONS:** \*Add records would create patient’s medical records in the DApp. It contains the fields of ID, name, co-morbid, blood group, and IPFS hash. The patient’s basic medical records is stored along with the IPFS hash that contains the file uploaded containing the lab results or other \*Update records would update the medical records of patient. This can only change the basic medical records of patient. information of the patient not the IPFS hash. IPFS hash is non-updateable to ensure security of View records would let the user view the medical records of a patient stored in DApp. \* View records function is used both by doctors, patients and Insurance Agent. The patient can view his records by the system authenticating that patient views only his own medical records. For this purpose system uses the public account address of the patient to ensure that only the relevant medical . \* Delete records would make the user be able to delete record of any patient. The user here records is shown to the patient would be the doctors they are given this right to delete any patient’s record stored on the \* Grant access for each of the above mentioned transactions, certain user would need to have blockchain. access to them, i.e., only the doctor can make changes in the records of the patient or add them. So, add and update records would only be accessible to these entities. Moreover, patient can view his medical records but won’t be given the access to add or update them.

**3) SYSTEM IMPLEMENTATION** As already explained in the previous sections, the system was implemented by using the Ethereum and its dependencies. This section explores system implementation in more detail to get an insight on the system various functions. **SMART CONTRACTS** As explained earlier, smart contracts are an important part of DApps as they are used for performing basic operations. Following contracts are included in this framework: Patient Records and Roles These contracts are used for giving access to the users on the DApp and performing CRUD operations on the records of patient

FIGURE



### 3.ANALYSIS

The patient can share his/her records to the doctor and he can pay and claim the insurance as well. The doctor can access the patient record’s only if the patients share. The main role of doctor here is to access patients records and to give them required treatments. The Insurance Agent can view the records of his patients and release the claim when required to the doctors account directly. Here we used the Blockchain to store the records as it provides more security to the records .

### 4.RESULTS

We have done the testing and got the best results. We stored the records of a patient and given access to doctor and payed the insurance. The doctor provided the patient with the prescription and the Insurance agent viewed the records of his patient and released the claim to doctor

### 5.CONCLUSIONS

In this paper we discussed how blockchain technology can be useful for healthcare sector and how can it be used for electronic health records. Despite the advancement in healthcare sector and technological innovation in EHR systems they still faced some issues that were addressed by this novel technology, i.e., blockchain. Our proposed framework is a combination of secure record storage along with the granular access rules for those records. It creates such a system that is easier for the users to use and understand. Also, the framework proposes measures to ensure the system tackles the problem of data storage as it utilizes

the off-chain storage mechanism of IPFS. And the rolebased access also benefits the system as the medical records are only available to the trusted and related individuals. This also solves the problem of information asymmetry of EHR system. For the

future, we plan to implement the payment module in the existing framework. For this we need to have certain considerations as we need to decide how much a patient would pay for consultation by the doctor on this decentralized system functioning on the blockchain. We would also need to define certain policies and rules with the principles of the healthcare. We conclude that Blockchain technology might be a future suitable solution for common problems in the healthcare field, such as EHR interoperability, establishing sharing trust between healthcare providers, auditability, privacy, and granting of health data access control by patients, which would enable them to choose whom they want to trust and with whom to share their medical records

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