IJCRT.ORG ISSN : 2320-2882
INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

HEALTHCARE BLOCKCHAIN USING BIGCHAINDB

[1]A Srujan Kumar, [2]Dr K Raja Kumar

[1]Student (M.Tech) Cyber Security and Data Analytics, [2]Assistant Professsor of Dept. Computer Science & Systems Engineering
[1]Dept. of Information Technology and Computer Applications,
[1]Andhra University College of Engineering, Visakhapatnam, India

Abstract: In recent years, a widespread interest has been received by the blockchain technology. Many healthcare systems have been developed using blockchain technology in these years which has used traditional databases as their database to store records which is a centralised database. In this paper, we have proposed blockchain database bigchaindb for storing medical records which is decentralized, immutable, and has control on the assets over the network. Also, we have constructed a web framework using Django which connects with blockchain database BigchainDB. This model verifies and validates the transactions that are stored in the database BigchainDB. Finally, we have implemented a prototype called healthcare blockchain using bigchaindb which gives security to the medical records stored in the database which is a scalable blockchain database and includes the features of decentralised control, tamper resistant, immutability, fault tolerance, and advanced access control.

Index Terms - **Healthcare, Blockchain, BigchainDB, medical records, decentralised, immutability, fault tolerance.**

I. INTRODUCTION

A Blockchain is a list of amplifying records, called blocks, where the blocks are connected to each other using cryptography. Blockchain permit peer-to-peer transfer of digital assets without any third parties. Each and every block contains SHA 256 hash of antecedent block, timestamp, and transaction data. Many of the blockchain applications built have been using traditional databases for storing the data. In healthcare, data plays a vital role in treating the patients and blockchain has been suggested to be a better solution for healthcare data management [1].

Since, blockchain allows peer-to-peer network, all the peers in the network use a protocol in common which specifies the communication between the blocks and validates the block when a new block is created. During this article, we focus mainly on the aspect of storing medical records using blockchain database bigchaindb which has the features of decentralised control, immutability, and fault tolerance. Blockchain is the combination of all transactions within the blocks where all the blocks contain the hash of the preceding block which makes hard for hackers to tamper the data [2].

To this end, we propose a web framework prototype healthcare blockchain using bigchaindb which stores the data in a secure way by deploying blockchain database bigchaindb which has the features of no single point of control and no single point of failure. Also, we have constructed a user interface using Django framework which interacts with the blockchain database bigchaindb and the users, i.e., doctor/patient.

II. OVERVIEW OF BLOCKCHAIN TECHNOLOGY AND BIGCHAINDB

In this section, we discuss briefly about the history of blockchain technology and bigchaindb and their related terminology.

2.1. ORIGIN OF BLOCKCHAIN AND BIGCHAINDB

Blockchain was first developed by Stuart Haber and Scott Stornetta in 1991 and came into existence in 1992 through which the above scientists developed a model of document timestamps which are not easy to tamper. Blockchain is a decentralised network, i.e., chronological chain of blocks where every block stores the data of network activity as all the blocks are present in the chain [3]. Since, blockchain is a distributed ledger, it achieves consensus mechanism which ensures ordering of transactions in an explicit way and guarantees the integrity and consistency of blockchain [4].

BigchainDB was developed by Bruce Pon and came into existence from February 2016. It was developed based on the idea of blockchain characteristics and database characteristics which emerged as a powerful blockchain database storage as the traditional database is centralised and is pathetic. There are three main characteristics in BigchainDB which are decentralised control, immutability, and transfer of digital assets [5]. BigchainDB uses NOSQL database as an underlying database which is a schema free. So, MongoDB was employed as an underlying database as it is most popular.

2.2. SMART CONTRACTS

Smart Contract is a protocol of digital contract came into existence in 1994 and developed by Nick Szabo [6]. Smart Contract provides computational logic layer which gets executed on the blockchain and looks like an object oriented model class definition. Generally, smart contracts are written in high level programming languages such as python, solidity, etc.

2.3. BITCOIN

Bitcoin is one of the most popular digital currency or cryptocurrency came into existence in 2008 and developed by Satoshi Nakamoto. As Bitcoin permits peer-to-peer network, it allows online payments to be sent directly from one participant to another participant without the interference of third parties such as financial institutions, etc. It also solves the problem of double spending in blockchain technology as it permits peer-to-peer network [7].

2.4. HEALTHCARE

A number of healthcare blockchain applications have been developed till today. Many have developed healthcare blockchain applications for the purpose of securing medical records and transparency. As healthcare blockchain plays a vital in monitoring doctors and patients accordingly, in providing effective treatment for patient's illness as life of a patient is more important. Hence, blockchain in healthcare has been used widely in present situation.

III. PROPOSED METHOD

In today's world, healthcare blockchain systems are playing a vital role in healthcare industry and the data i.e., medical records play an important role in rescuing the patients' life. All healthcare blockchains are being developed using traditional databases to store the medical records but the traditional databases do not satisfy many of the blockchain requirements. This is the problem where we have focused on this paper.

In our proposed method, to overcome the above problem, we have proposed blockchain database called BigchainDB which has the features of decentralisation, immutability, and fault tolerance. Also, our proposed overcomes the properties present in the traditional databases such as single point of control and single point of failure. Following is the proposed system architecture of our project.

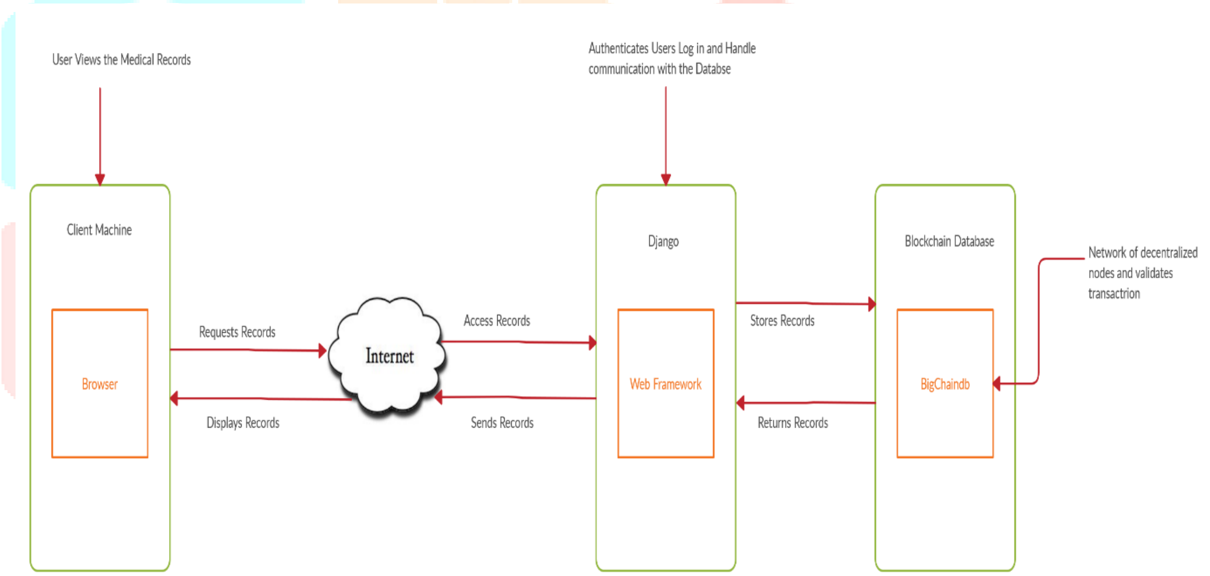

Figure: Proposed System Architecture

IV. LITERATURE SURVEY

We have studied papers based on Blockchain Healthcare and BigchainDB. Some of the papers describe how to implement healthcare using blockchain technology and also implements a consortium blockchain for improving the accuracy of diagnosis and the effectiveness of the treatment. Remaining papers describe how BigchainDB is implemented in blockchain technology and how blockchain communicates with its decentralised database BigchainDB. Also, we have studied how to secure data using blockchain technology.

"Shuai Wang, Jing Wang", the authors proposed healthcare blockchain which uses ACP approach in modelling the patients' health conditions, diagnosis statistics, and the process of treatment. In this paper, they also constructed a consortium blockchain which links patients, hospitals, and health bureaus together to share healthcare data, i.e., medical records which provides care auditability [8].

"Vamshidhar Reddy, Jaya Prakash Reddy", the authors proposed blockchain database called BigchainDB which is a decentralised database and has the characteristics of immutability, low latency, and high transaction rate. They also implemented how the transaction process takes place and also implemented the creation and transfer of transactions using BigchainDB. Here, they store face expression gestures in blockchain database BigchainDB [2].

"Yajun Wang, Chao-Hsien Hsieh", the authors discussed the difference between the traditional databases and BigchainDB. Also, they compared the performance of creating and querying transactions between the traditional databases and the

BigchainDB. They also discussed architecture, characteristics, and basic operations of BigchainDB. They also implemented how to create an asset and how to transfer an asset and also implemented search query on all the assets [3].

"Vikas Jaiman, Visara Urovi", the authors proposed smart contracts which provides consent of individual's health data dynamically and also helps requesters in searching and accessing the data which the smart contracts enables. Also, they proposed two ontologies in modelling the dynamic consent. The two ontologies are Data Use Ontology (DUO) which helps in modelling the consent of individual users and the other ontology is Automatable Discovery Access Matrix (ADA-M) which gets queries from the requesters of the data. Finally, they have implemented a project called LUCE which runs on the top of Ethereum Blockchain which is written in Solidity Language [9].

"Konstantinos Tsoulias, Georgios Fragkos", the authors developed a decentralised model in Python which uses RESTful APIs for the communication of nodes by invoking suitable APIs. They used Neo4j to obtain a graph based blockchain which achieves consensus mechanism through Proof of Work (PoW) and Proof of Stake (PoS) protocols. They also used SHA 256 algorithm in encrypting data that stores in Neo4j [4].

V. METHODOLOGY

In this project, we have implemented a web framework called healthcare blockchain using bigchaindb. In this web framework we used HTML/CSS and JavaScript for the user interface and for the backend we used BigchainDB and Django. For the user interface, log-in screens were implemented in different places in the case either the doctors or patients can use the application. Also, we have designed the use case diagram which is as follows.

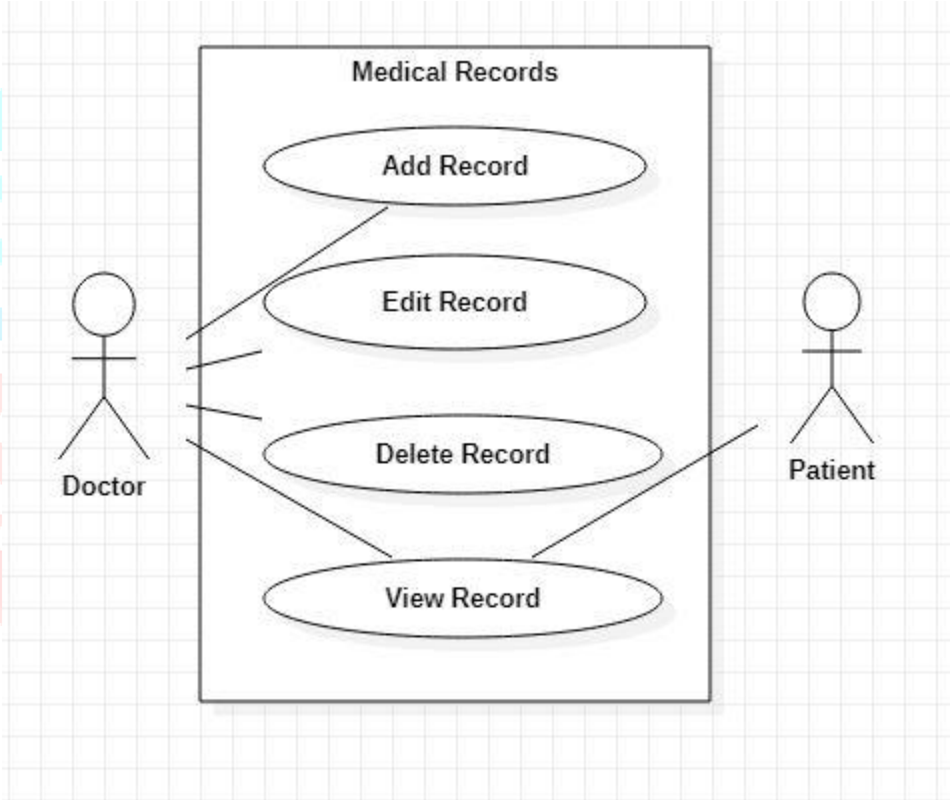

Figure: Use Case Diagram

Add Record: After login, i.e., validation of doctor's credentials, doctor can add new record. The new record gets saved directly to the database after adding. Only the doctor can add record as he/she is the sole administrator.

Edit Record: Here also, only doctor can edit the record or update the record of a particular patient. This happens only after the doctor verifies his/her identity by providing credentials and validates identity.

Delete Record: This operation is also done by doctor itself. But deleting particular record does not get deleted in all nodes instead doctor should delete the record present in each and every node separately. This operation is performed only after the doctor validates his/her credentials by logging in.

View Record: Here, both doctor and patient can view the records or access the records. When the patient accesses his/her own record, it retrieves the record from the database and displays through the web browser. Both doctor and patient can view the records only after verifying their credentials by logging in.

VI. IMPLEMENTATION

A prototype called healthcare blockchain using bigchaindb has been developed which is written in high-level language python. In this paper, we require ubuntu as hardware environment and Django, MongoDB, and BigchainDB are required for software environment. While running the project, we have different login pages such as home page, doctor login page, and patients' login. In home page, we have two options which are New patient and Existing patient.

When we try to access New patient, it will redirect to doctors' login page where the doctors' login by validating their credentials. After login, we can see user profile where we can add new patient or edit the existing patient record. After adding new patient, the patients are provided with their credentials to view their medical history. While adding patient, they have to complete a form which contains patients details such as name, age, gender, date of visit, etc. Also, it has illness, doctors treated, previous doctors, current doctors, medication given, etc. After adding all these details, it will get added to the BigchainDB database. Also, doctors can get the recent actions took place in the profile.

When we try to access existing patient, it will redirect to the patients' login page where the patients' can view their medical records by providing their credentials. Once the patient logins, patients' can see their medical records which consists of information in four tabs such as General Information which describes their name, age, gender, etc. The other tab is previous doctors/current doctor who has given the treatment provided with doctors' information. In the illness tab, they can see their illness occurred and symptoms of illness and in the medication tab, they can see the treatment given for their illness. The above information is retrieved to the patients' through Django which is the python backend.

After this, we will add the block into the blockchain with the information inside the code in JSON format which displays a hash code with the message transaction is validated. Now copy this hash code and paste it along with BigchainDB web API URL in the browser to view the data which has been added to the blockchain. This is how we can validate and verify the transactions in BigchainDB.

VII. CONCLUSION

In this paper, we have given the key differences between bigchaindb and the traditional databases and described how bigchaindb works effectively than traditional databases in storing the medical records. Also, we have given the characteristics of bigchaindb and we have described how traditional databases are not suitable for blockchain data storage. Finally, we have described how bigchaindb emerges as an effective solution for satisfying the requirements of blockchain data storage through implementing the project healthcare blockchain using bigchaindb.

VIII. REFERENCES

[1]. Vikas Jaiman, "A Consent Model for Blockchain-Based Health Data Sharing Platforms". [Online] Available: https://ieeexplore.ieee.org/document/9159120.
[2]. Vamshidhar Reddy, "Automatic Face Expressions and Gesture Detection System using Blockchain Security". [Online] Available: https://ieeexplore.ieee.org/document/9160325.
[3]. Yajun Wang and Chao-Hsien Hsieh, "Research and Analysis on the Distributed Database of Blockchain and Non-Blockchain". [Online] Available: https://ieeexplore.ieee.org/document/9095589.
[4]. Konstantinos Tsoulias and Georgios Fragkos. "A Graph Model Based Blockchain Implementation for increasing performance and security in decentralised ledger systems". [Online] Available: https://ieeexplore.ieee.org/abstract/document/9130718.
[5]. BigchainDB white paper. [Online] Available: bigchaindb.com/whitepaper.
[6]. Asma A. Alsufyani, "Application of Blockchain in Healthcare in Saudi Arabia". [Online] Available: http://www.ijcst.com/vol11/issue1/2-mehedi-masud.pdf.
[7]. Satoshi Nakamoto, "Bitcoin: A Peer-to-Peer Electronic Cash System". [Online] Available: https://bitcoin.org/bitcoin.pdf.
[8]. Shaui Wang, "Blockchain powered parallel healthcare system based on ACP approach". [Online] Available: https://ieeexplore.ieee.org/document/8449329.
[9]. Vikas Jaiman, "A Consent Model for Blockchain-Based Health Data Sharing Platforms". [Online] Available: https://ieeexplore.ieee.org/document/9159120.