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Blockchain and its role in handling biomedical transactions

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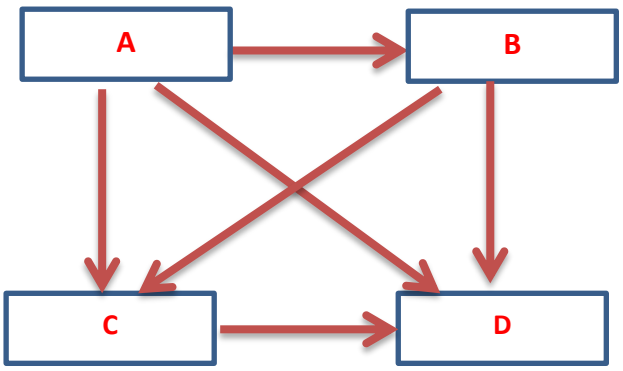
Introduction

Blockchain technology [1,2] was introduced around the year 2008 for processing crypto currency application known as Bitcoin. Bitcoin used as a digital currency, monitored by the users in a peer to peer network and importantly not monitored by government agencies like central banks. Blockchain technologies are kind of distributed databases (ledgers) which are managed by the users in the network. The Blockchain technology is now used in different fields such as healthcare [3,4,5] apart from the financial sector. Advantages of Blockchain Technologies are decentralized management, unalterable(immutable) & verifiable transactions, reduced risk of network failure, reduced risk of loss due to hacking and it is secured as it uses encryption technologies to store the information. The paper starts with an overview of Bitcoin Blockchain technology, its structure and workflows and provides insight into role of Blockchain technology in biomedical transactions.

Keywords: Blockchain, smart contract, proof of work, proof of concept, healthcare, biomedical

Bitcoin Blockchain

In the traditional system of financial transactions if the central administrator in the network is down (in the case of financial transactions it will be the central banks) then it will result in stopping all transactions among the users in the network. The Bitcoin network avoids this problem as the transaction is directly between the users in the network without an inter-mediatory. The problem of fraudulent transaction [5] such as sending the same Bitcoin twice in the network is also avoided due to the fact that each transaction in that particular Bitcoin network is visible to all users in the network and hence the repeated transaction of the same coin is prevented. Each user stores the transaction in the network through the time stamping mechanism [56]. It helps the user to verify which transaction in the network happened first and hence the duplicate transaction is avoided



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For example user 'A' has completed a transaction with user 'C' for a Bitcoin X then when A wants to send the same Bitcoin to user 'B' will be prevented as the transaction between the user A and C is stored across among all the users in the network including the user B with the timestamp.

Structure of Blocks in Bitcoin

Each block in the Blockchain contains the following structure

i. Hash tag[5,6] of the previous block in the network which helps the network to form a chain
ii. Transaction details
iii. Nonce counter[5] which acts a counter to store the transaction in network which is incremented by 1 when a transaction occurs in the network

Proof of work protocol

Whenever a successful transaction is completed in the Blockchain network, a new block is created through proof of work protocol [5, 6] by the node which completed that transaction first. The newly created block is then added to the Blockchain network after the users in the peer to peer network verify and approve the transaction and all the other nodes which are working on the particular transaction will be drop their transactions. The whole process of adding a new block is called mining in Blockchain

Bitcoin Blockchain alternatives

There are several Bitcoin alternatives came into picture such as Ethereum [3,4, 5] which is used as smart contracts by Microsoft corporations

Blockchain Technologies in Biomedical domain

Blockchain technologies started playing an important role in biomedical domain [7,8,9,10,11,12] in the following areas:

i. Electronic Medical Records

Storing patient data in electronic medical records as distributed ledger [13, 14] resolves the interoperability problems and enhances the sharing of health information among stakeholders. It reduces the security risks as it uses encryption technologies and ensures that the patient records are available to the concerned individuals.

"MedRec" is one of the example of decentralized electronic record management system [13] which uses Ethereum smart contract Blockchain technology and proof of concept protocol. MedRec provides patients with the access to their electronic medical records at any point of time and share the same with different health care providers.

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OmniPHR [14] is a Blockchain based personal health record model which address the access needs of the patient and health care professionals by integrating personal health information spread among different devices.

ii. Prevention of counterfeit drugs

Using the Blockchain technologies properties of immutable transaction, the prescription of counterfeit drugs can be reduced to a greater extent as the prescription of drugs will be monitored during the transactions in the Blockchain [15].

Iii. Information exchange in healthcare

Fast Healthcare interoperability Resources (FHIR) is an emerging standards from the Health Level Seven (HL&), the International healthcare standards organization. FHIR along with the Blockchain technology can be a useful tool for information exchange [16, 17]. It addresses the interoperability and security issues as It uses the proof of interoperability concept in the Blockchain.

Iv. Blockchain in Health insurance

Blockchain can play an important role in Health insurance field as it involves smart contracts technology to process the health insurance claims [18]. It will reduce the time for processing and prevent fraudulent transactions.

iv. Blockchain in clinical research and trails

There are numerous clinical studies and researches are conducted throughout the world creating large amount of data and Blockchain technology can help to integrate the vast amount knowledge which can be shared among the professionals and at the same time confidentiality and security can be maintained[19,20,21]. The proposed healthcare Blockchain network such as ModelChain [22] will help us to carry out predictive modeling at the same time protecting the privacy of the data.

v. Blockchain in Healthcare supply chain management

With the use of smart contracts, the Blockchain technology can help the healthcare organization in managing their products supply chain as it saves cost and reduces failures in obtaining the required products in case of emergency [18].

Challenges for Blockchain technology in Healthcare

The implementation cost for Blockchain technology seems to be high in the current scenario and perceived risk related to privacy [11, 23] and patient identification remains in the minds of Healthcare professionals which need to be sorted for the effective implementation of Blockchain technology in the healthcare.

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Conclusion

The paper provided an overview of Blockchain architecture, its uses in biomedical transactions and challenges faced in implementation of the Block chain technology in the same.

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