Block Chain and Its Application in Health Care

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Abstract- Block chain technology has existed from 2008.Blockchain is a ledger, a distributed ledger that consists of digital recording of the history of transactions. Bit coin, a powerful concept proposed by Satoshi Nakamoto was developed using Block chain technology. However, with time, it has become clear that block chain technology is likely to have an impact on other areas other than just the cryptocurrency domain and much deeper than simple distributed ledger storage. In this regard, we discuss its application in the field of health care. As we are in an information technology world, we have started moving to use EHR's (Electronic health records), instead of handwritten ones .since block chain has already gained success in financial sector ,there is a scope to use this technology in health care as well. This paper is divided as introduction, overview, architecture, challenges, current trends and its application in health care..

Keywords: Block chain, Bitcoin, cryptocurrency Ledger

1. Introduction

A blockchain is type of database that contains digital ledger (or) relational databases. They are distributed across a network of computers i.e., they are not centrally managed and the transactions are shared among all the participants of the blockchain network[1].Blockchain was first started in 2009 to support the cryptocurrency"Bitcoin".It is like a public ledger and all transactions are stored in the form of blocks.Here, new blocks are appended continuously and increases in size.Characterstics of blockchain are decentralized,persistency,anomity and auditability all these features of block chain reduces the cost and improves the efficiency[2].In principle, any type of data can be stored in Blockchain[3]. The blockchain technology is an information technology that combines cryptography, peer-to-peer computing and incentives to enable systems with networked trust where system wide consensus among the peers is achieved by different mechanisms..Cryptography plays a major role in the design of this new technology. Bitcoin has expanded to a global network consisting of thousands of computers. It was proposed as an alternative to the traditional currency system to enable virtual transfers between untrusted parties over the internet and to prevent double spending It is open source, decentralized and the transactions are recorded on a publicly available distributed ledger-like data structure called the blockchain. The blockchain is literally what the name implies, a chain of blocks, and a block contains all the transaction records for a specific period of time which at present is 10 minutes for Bitcoin Any user can access the entire history of transactions ever made by scanning the blockchain, all the way back to the first transaction of the first block on the open ledger. The blockchain is not stored centrally but rather available for download freely and thus distributed and replicated throughout the network[4].block chain is the emerging technology and it can be applied to health industry for EHR's, drug supply, claim and billing.

2. Overview

A blockchain uses digital signing (also called hashing), along with public-private key cryptography, to build a chain of clear text evidence about the past transactions. It uses the fundamental

trust mechanism (i.e, the consensus mechanism).Being a decentralized system, it does not require a third party, instead it adopts the decentralized consensus mechanism. In paper [5], four major consensus mechanisms are discussed namely:PoW(proof of work), PoS(proof of state),PBFT(practical byzantine fault tolerance) and DPoS(Delegated proof of state).Few more mechanism like PoB(proof of bandwidth),PoET(proof of elapsed time),POA(proof of authority)and so on are also used. Blockchain is secure by design and relies on well known cryptographic tools. Recently smart contracts have emerged to digitize and automate the business workflows. Many studies have been made on this technology in general, but the application of this is not beyond digital currencies in most of literature reviews . Block chains are classified as public and private. In public blockchain, parties make secure transactions in trust-less environments. In private, one entity rules the whole system whereas members share the authority among them, i.e. the infrastructure is centralized in case of private blockchains. Paper [6], lists the blockchain components.

Figure 2.1 Components Of BlockChain

1. Network of nodes: All the nodes in the internet maintain all of the transactions made in blockchain collaboratively. It eliminates the third party for validation.

2. Distributed database: The database is composed of blocks of information. It is copied to every node of the system. Timestamp is used to link nodes.

3. Shared Ledger: It is updated every time a transaction is made.

4. Cryptography: Hashing is used to apply cryptography.

A specific cryptographic hash function used in many blockchain implementations is the secure hash algorithm (SHA) with an output size of 256 bits (SHA-256). In [7], cryptographic hash functions are given in detail. Hash function is used for address derivation, to create unique identifiers, for securing block data and block header.

3. Architecture
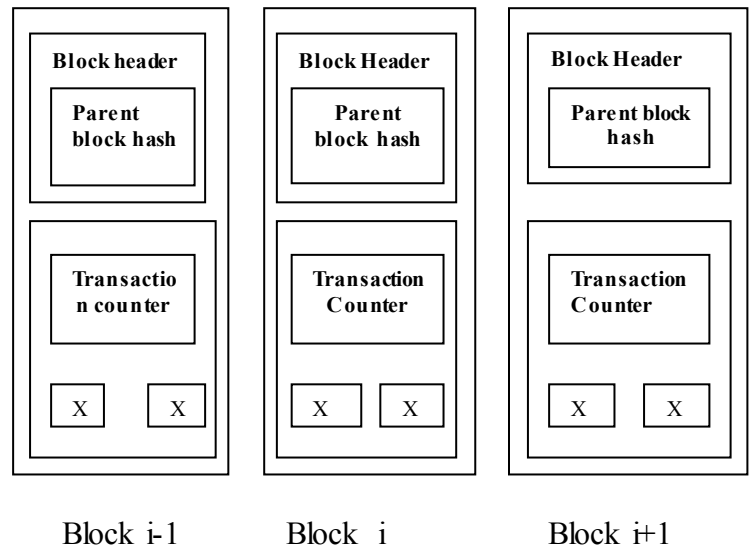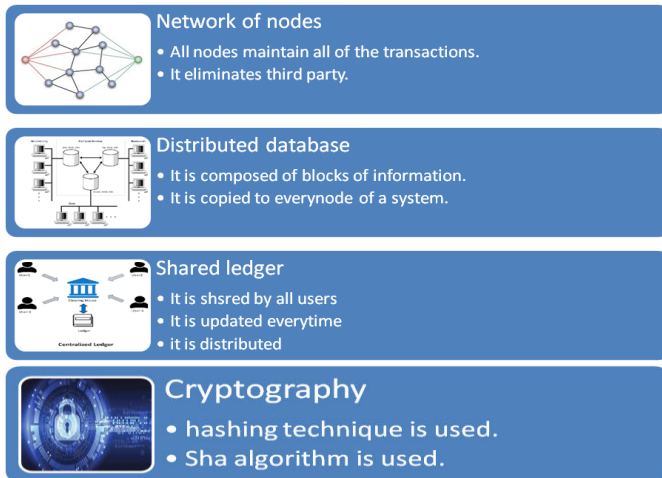

Block i-1   Block i   Block i+1

Figure 3.1 :Architecture

The block chain is the plain of squares which holds an entire once finished off exchange records like a standard open record[8]. As shown in the figure 3.1, block chain consists of sequence of blocks that holds an entire list of records like a public ledger[9].it consists of a 256 bit hash value that points to the previous block.

A block consists of the *block header* and the *block body*.
The block header includes:
(i) *Block version*: Indicates that set of block validation rules to follow.
(ii) Merkle tree root hash: The hash worth of all the transactions within the block.

(iii) Timestamp: current time as seconds in Greenwich Mean Time since Jan one, 1970.

(iv) nBits: target threshold of a legitimate block hash.

(v) Nonce: associate degree 4-byte field, that sometimes starts with zero and will increase for each hash calculation

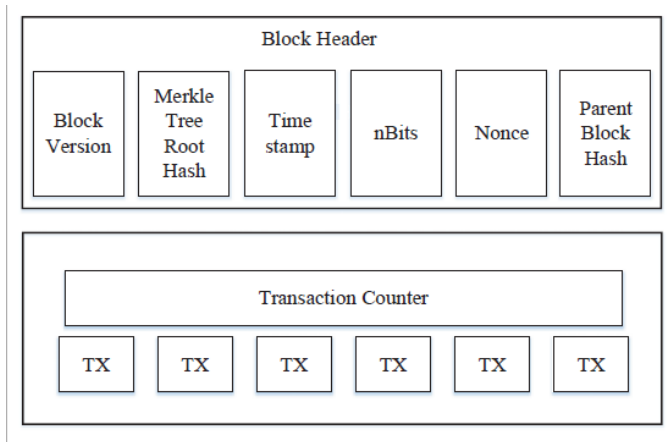**(vi)** Parent block hash: A 256-bit hash worth that points to the previous block.

Figure 3.2 :A Block

3.1 Characteristics of Blockchain

Th block chain has four main characteristics as in paper [10].

Table 1: characteristics

Characteristics	Meaning
Decentralization.	There is no need of trusted third parties.
Persistency	Not possible to delete or rollback transactions once they're enclosed within the blockchain. Blocks that contain invalid transactions may be identified directly
Anonymity	Every user will act with the blockchain with a generated address, that doesn't reveal the identity of the user
Auditability	Any dealings must ask some previous unexpended

	transactions. Therefore, transactions may well be simply verified and tracked.

The above table has listed the characteristics if block chain .

4. Challenges

Paper [11] discusses the challenges in implementing block chain. Throughput, Latency issues, Size and bandwidth issues, Scalability issues, Cost issues, Data malleability issues, Authentication issues. Privacy issues. Double-spending attacks, Security issues, Wasted Resources, Usability issues, Versioning, hard forks, multiple chains. Paper[12] discuses, Storage optimization of blockchain, Redesigning blockchain, Privacy leakage.

5. Current Trends

As blockchain is widely applied to cryptocurrency bitcoin, it is not limited to this domain it can be applied in various other fields as listed in table.

Table 2:current applications

Application	usage
Asset Management	The blockchain is employed right from serialization to being deployed on the floor .asset can be a server,computer or a software/service.
Real estate	Blockchain will enable every property to have a corresponding digital address and maintains the entire history in ledger.
finance	A very important process, which becomes quite expensive and sluggish, due to the presence of middlemen is cross-border payment Block chain reduces the cost in real time transactions across borders.
IOT	IoT solutions using blockchain can be built to maintain a continuously growing list of cryptographically secured data records protected against alteration
Healthcare	Block chian based

	management of patient health records that can be accessed by doctors across and insurance providers.

The table 2 has listed out the various areas where blockchain can be applied. now let us discuss about health care in next section

6.Block chain in health care

Healthcare is a data-intensive clinical domain where a huge amount of data are generated, accessed, and disseminated on a regular basis. Storing and disseminating this large amount of data is crucial, as well as significantly challenging, due to the sensitive nature of data and limiting factors, such as security and privacy. Electronic Health Records (EHRs) are not created to handle lifetime records among multiple institutions, and patients leave their data scattered among various institutions as life situations separate them from one provider's data into another; in this way, they lose the data access . Having faced these limitation,critical need of an innovative way to handle EHRs in a way that encourages patients to engage in their current and historical healthcare data, many researchers have brought up blockchain technology in maintaining the EHRs[13].
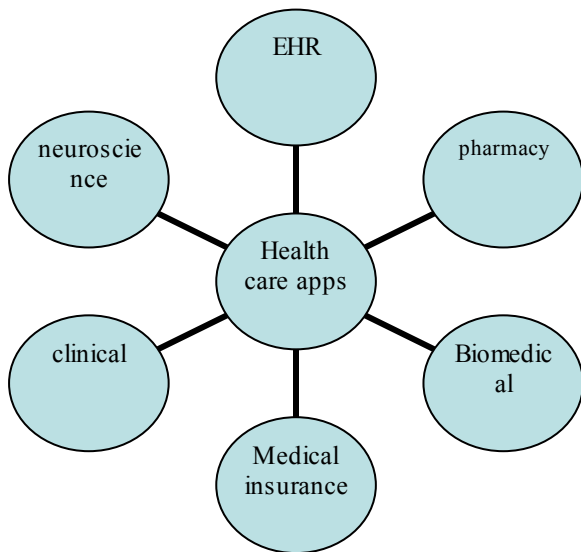
The figure above lists out how block chain can be applied in various parts of healthcare. Block chain is a new technology which has its own opportunities and challenges. since patient data is very sensitive there is lot of challenges involved in maintaining the privacy and data integrity. There are three types of blockchain namely, public,private and consortium.paper, discusses the three types of blockchain with respect to EHR.

1.**Public**: A public blockchain involves countless nodes that can participate from anywhere in the world. Anyone can read the blockchain and help verify if transactions are valid. This type of blockchain is completely decentralized, meaning nobody is a single owner of the blockchain
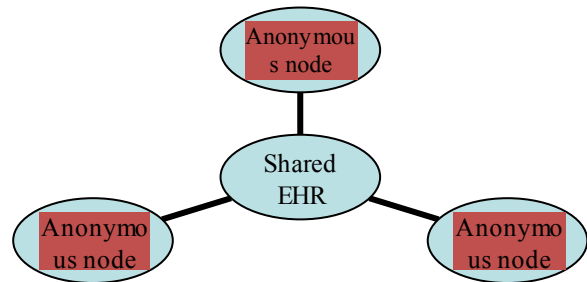

Figure 6.2: EHR in Public block chain.

2. **Private:** A private blockchain is one where the reading and writing is all done by one central organization. The private blockchain has a predetermined number of nodes, each of which works with each other to determine consensus to changes in the blockchain.
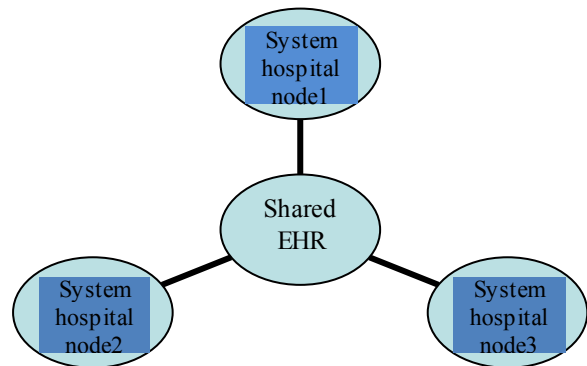

Figure 6.1: blockchain applications in healthcare

Figure 6.3: EHR in Private block chain.

Consortium Blockchain: It is the one where a predetermined number of nodes verify changes to the distributed ledger. Unlike the private blockchain, the consortium blockchain is shared amongst a group that has similar desires in accessing the information. This may be used in applications where a slight decentralization would be good for security, but complete decentralization would not make sense.
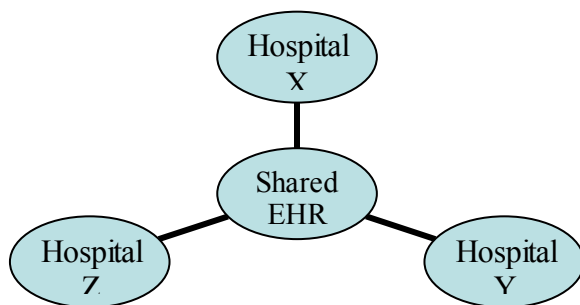

Figure 6.4: EHR in Consortium block chain.

Paper [14], discusses the barriers in implementing blockchain for healthcare. The first barrier is related to the large size and volume of clinical data. As High-volume and high-frequency transactions are a cornerstone of clinical data, and the size of clinical data is increasing exponentially with modern advancements in technology, it is difficult to manage the large amounts of data. A second challenge relates to privacy and security. Some implementations of blockchain technology are pseudonymous— identity is typically obscured behind a public key, but other attributes of transactions are publicly shared. This is problematic for health data. The largest barrier to adoption relates to incentives. Though EHRs are now required by law to have patient-facing APIs, the same is not true for all healthcare data, and incentivizing institutions to build patient-facing data connections without financial motivation to do so will be

challenging—the difference between compliance and true interoperability.

Let us consider how blockhain can be applied in healthcare a scenario: Any provider backend and user interface implementations can participate in the system by employing the modular interoperability protocol as defined through our blockchain contracts.the health data is encrypted and stored in blockchain and then sent back to individuals.the figure 6.5 shows how the technique can be used in healthcare.
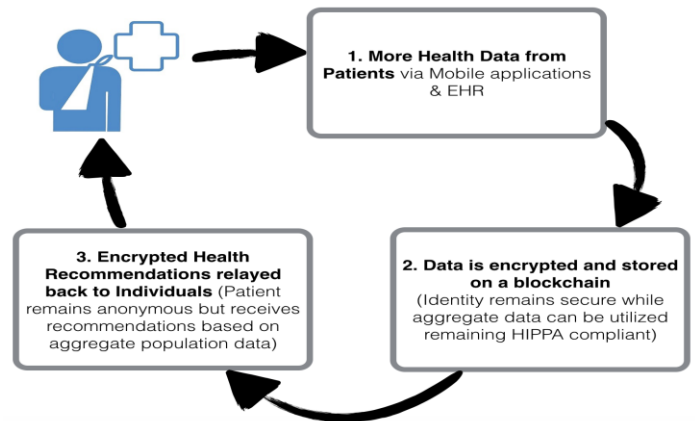

Figure 6.5: Block chain in healthcare

7. Conclusion

Blockchain technology is a novel technology which is successfully deployed in cryptocurrency "bitcoin" and it is not limitedto this, it has a huge potential to impact few other industries as discussed in applications.since we are in the world of digitization, healthcare is moving towards EHRs so, The adoption of blockchain technology in healthcare has started and we can expect to have commercial blockchain solutions in the market in near future. In this direction, there is lot of scope for future work.

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