BLOCK CHAIN IN HEALTH CARE SYSTEM

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ABSTRACT-: *Due to irrecoverable disease's organ transplant and drugs traceability becomes vital for human beings. But due to some intentional and unintentional reasons organ transplants and drugs can be abused for patients. In this paper, we introduced block chain to counter such mismanagement and trace the real donor/receiver of the organ. We used multiple test cases using Blockchain to validate our research statements such as medical record treatment, organ transplant, and drug traceability. Results show that with the use of Blockchain almost 100 percent error chances are removed.*

Keywords—Block chain; healthcare

I. INTRODUCTION

Researches scripting beneath the titled of Satosh Nakamoto published an article in 2008 known as bitcoin that is an e-transaction system. The Bitcoin can be divided into two components. Firstly, you have the token of Bitcoin that piece of code shows the possession of digital ideas such as an effective IOU but secondly, bitcoin- is the procedure, a distributed system that keeps tracking the ledger equilibriums that is bitcoin-the-token. Both branded as bit coin. The document frameworks that explain how to deal with a digital currency that will be more flawless and protected deprived of momentary over a principal consultant, such as a bank or reimbursement doorway. They discover a peer-to-peer e-cash scheme that would permit a connected transaction towards guided directly between two parties without participating in the financial institutions [1-5].

The first realization concept was Bitcoin. January 2009 Satoshi Nakamoto introductions Bitcoin as a substitute to the current economic system and Centre's of power. Now another word is cryptocurrencies that are castoff to define entirely systems and mediums of interchange that routines cryptography to safe businesses beside individual's classifications somewhere the businesses are guided over a consolidated reliable entity. After a few weeks later, an exposed cause package instigating the novel practice was unrestricted that originated with the Genesis chunk of 50 coins. Somebody can become part of the Bitcoin peer-to-peer network after the installation of this open-source program. They elected Peer to peer electronic cash version made for a public debt known as block chain or bitcoin technology which impact to every industry from financial, educational and manufacturing organization [6-10].

A block chain stands a dispersed database that is cast-off to preserve an endlessly mounting grade of archives, named chunks. To each block contains a timestamp with a link to a previous block. The pointers only precise data pointed not the document location. The pointer would become invalid if the data changed. It ensured once passed through data to the server then no one could tamper the data. A blockchain can assist by way of 'an exposed, disseminated record that is able to record transactions among two gatherings professionally in addition in a secure way. 'Block Chain is distributed ledger open and anyone can host but if any data once to write then doesn't allow anyone to an amendment that is an answer of digital trust. It's a transparent, time-stamped digital document and decentralized. A method of digital documents time-stamping with two properties. Without any person or party participation Auto time-stamping medium on which the data appears. A stamped document with date and time different from the actual one is impossible. It was a huge improvement without depending on the third party a user can directly enable the transaction .2010 set up the world's first cryptocurrency exchange known Bitcoin Market. In 2014 people shifted to block chain instead of Bitcoin. Block chain can be separated from the currency the world realized and can be applied to various other use-cases. Today's block chain is the biggest ground-breaking technology [10-15].

The block chain technology's main premise is to starts generating a dispersed system in the numeral connected domain. This consents sharing objects to identify the trust that a digital result transpired by producing an indisputable best in a public ledger. It unlocks the access for emerging a mountable numeral budget since a central one. Due to this disruptive technology remarkable opportunities and up healing in this space has begun. Particular convincing explicit solicitations in together monetary and non-monetary zone describes the blockchain technology. Now appearance on the encounters forward and corporate prospects in this essential skill that is completely agreed to transform our arithmetical domain. Now, for a brief moment to view the future of Blockchain. By 2022, at minimum, one state-of-the-art commercial manufactured on Blockchain skill will be worth $10 billion. By 2025, the commercial cost additional by Blockchain willpower cultivates to somewhat over $176 billion, formerly swell to surpass $3.1 trillion in 2030 [15-20].

II. BLOCK CHAIN ARCHITECTURE

In the beginning, try to know whatever is blockchain technology. Logically, a blockchain that remains a sequence of chunks which hold precise evidence (databank), nonetheless in reality that is a protected, authenticate method in a system that is grouped together in other words, we can say a block chain is a group of mainframes interconnected with every additional without any chief server system that is the entire distributed network. We want to mark it modest the idea of blockchain equated with effort completed by

googling [21-24]. You remember the passing days when incorporating completed for the papers to come for additional members to mark essential directs. Now the time change with the help of google dock or dropbox likely to graft on a similar article concurrently. The blockchain method is the distributed ledger that permits digital evidence to be decentralized, relatively than imitative. This distributed ledger delivers confidence, protection and statistics safety. Nowadays Blockchain style is mostly using in the financial sector [25-26]. This expertise is not individual working these days nonetheless is likewise for cryptocurrencies.

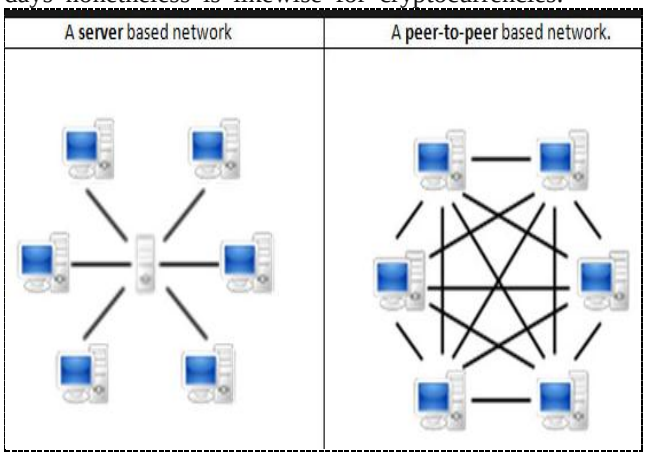

Figure 1Database vs. Blockchain Architecture

World Wide Web using the traditional architecture that Client-server model this scenario the server keeps a record of all accounts in a single room that is very relaxed to update in contrast a centralized database handled a number of administrators with permission. When discussing the decentralized network of blockchain architecture preserve, and approved new records for individual users contained by the network. The decentralized scheme not individual control each participant but everyone that associated the block chain system. But every participant in blockchain safeguards that all proceedings and procedure in the proper directive in this way parties are capable to stretch a shared agreement that not necessarily they trust each other. Inshore view, the blockchain is a disseminated database ledger for both public and private that can perform various types of transactions set by a P2P network that contains a number of processers, due to this the statistics cannot be change data without the consent of entire system [21-24].

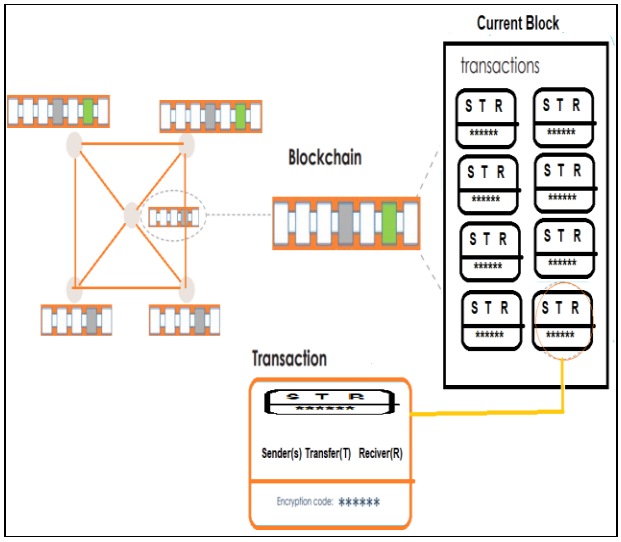

Figure 2 Blockchain Network in Distributed ledger

The blockchain technology structure shows in specific order transactions with a list of blocks. These lists are deposited in a smooth folder (txt. setup) otherwise in the system of a guileless database [25-26]. Very important two database assemblies hand-me-down in blockchain include:

Pointers –that are the variables that save details location about another variable and directing the location of an additional variable. **Linked lists** - blocks classification, wherever every chunk has precise statistics and associations to the subsequent chunk by the assistance of a pointer. In general terms, any block does not consist of pointer unless this one the first chain. In this way, no block possibly becomes the last block in the blockchain database which consists of the pointer with no value.

Fundamentally, the provided blockchain sequence linked list of records diagram:

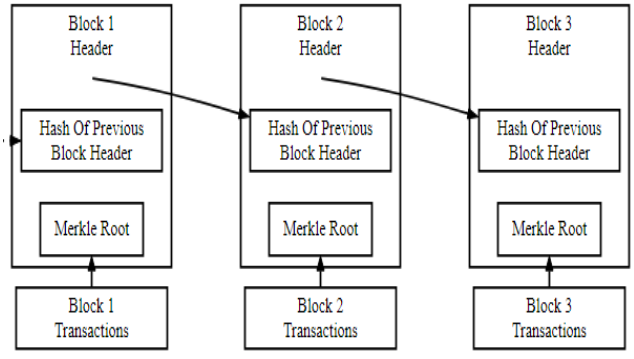

Figure 3 Bitcoin Blockchain

Types of Blockchain Architecture Explained

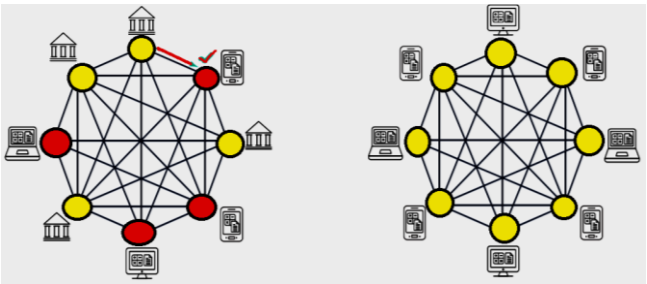

Figure 4 Validator Node Member Node

Both start/receive and validate the transaction, only start and receive the transactions. All blockchain structures divided into three major categories:

Table 1Comparison between three blockchain systems

Belongings	Public Blockchain	Private blockchain	grouping blockchain
Consensus determination	All miners	Within one organization	The selected set of nodes
Efficiency (use of resources)	Low	High	High
Centralization	No	Yes	Partial
Consensus process	Permissionless	Needs permission	Needs permission

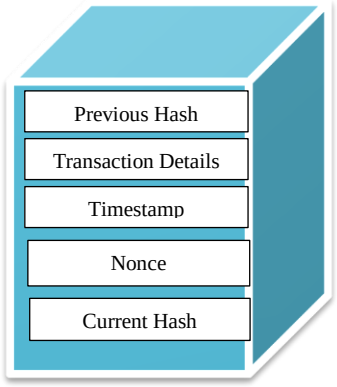

Figure 5 Typical structure of a Block

A blockchain is a continuously growing list of records (blocks) that are linked to each other as shown in figure-1 and secured using cryptography. Each block is digitally signed and hashed. Some of the distinguished features of blockchain technology can be classified as distributed, immutable, decentralized, proof of consensus and ability to keep transaction details of assets. Functionally, blockchain is a ledger available publically, not centrally controlled can record the transactions efficiently with secure and everlasting manner [1].

The **block** is a basic unit of blockchain, created by the miners, the typical structure of a block is very simple as shown in the figure-2, it contains of a chunk form and a chunk header. A block body comprises n-number of different transactions (Data) which are aggregated by the miner onto the block [2].

The header of the block can have five major attributes:

i. Previous Hash: hash of the previous block (reason in forming a 'chain')
ii. Transaction Details: metadata of the transactions in this block
iii. Timestamp: the time at which block is found or created
iv. Nonce: a random value (number used once), that blockchain miners are solving.
v. Current Hash: the hash of the current block

The steps of operation of a blockchain (as explained in the flow chat figure-3) in a network starts with new transaction records occur by broadcasting the transaction to the entire network [3]

III. RELATED WORK

This paper [2, 25, 26] suggests the performed study has shown the numerous benefits of IoT-powered waste management systems over traditional ones.

This paper [3, 24, 23] suggests the potential effort plan of an IoT-based discarded administration method. It enables the easier waste collection and optimizes resource utilization by the use of wireless sensors i.e.GPS and RFID. In this paper they discussed the current era trends are mostly smart (IOT) absurd control with the help of cisco-corporation. Awkwardly we cannot feel more secure due to susceptible and limited aptitude. They conducted a survey to find out major security issues for IOT. They categorized the most famous security issue according to IOT covered design and procedures for networking and message. They prepare the summary security requirements for IoT along with the existing attacks, threats map and state-of-the-art solutions. They discussed the block chain, Security Solutions for IoT, Blockchain Solutions for IoT Security.

IoT security problems [4,22, 21] have lot of objectives with IT security but IOT systems much more feelings, secrecy is required especially when these systems come in digitalize the private lives of users then find out key privacy concerns for IoT related to the collection of individuals'.But for protection requirements, the sensitivity IoT technologies stop due to IOT technology. After the usage of IoT devices raises a lot of security problems such as trivial cryptographic procedures in the relation of dispensation and memory necessities and was also very necessary to reduce the data size for the use of

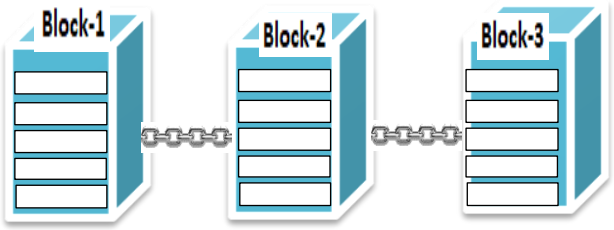

Figure 6: An example of blockchain

standard protocols exchanged between nodes.

It is easier to attach on IoT devices because of limited resources a large number of IoT devices with universal IP addresses, which identification of these IoT devices marked Security attacks autonomous operation and communication. In this condition, it's very essential for innovative and more robust security solutions for all IoT systems. Last four decades'. According to present research need to introduce generalized mechanism often known the name of block chain or decentralized ledger technology and its use in IoT environment [18, 19, and 20].

Table 2 Comparison of various Blockchain Protocols

Protocol	Bitcoin	Ethereum	Ripple	Hyper ledger	R3's Corda	Symbiont
Use Case	Payments Blockchain	General Purpose Blockchain	Payments Blockchain	General Purpose Blockchain	Specialized distributed blockchain for Financial Industry	General Purpose Blockchain
Currency	BTC	Ether	XRP	No Native Cryptocurrency	No Native Cryptocurrency	Byzantine, Assembly
Governance	Bitcoin Developers	Ethereum Developers	Ripple Labs	Linux Foundation	R3 Company	Symbiont's Company
Operation Mode	Public	Public or Private	Public	Public or Private	Private	Public or Private
Smart Contract	None	Solidity Programming Language	None	Golang /Multiple Programming Languages	Kotlin Programing Language	Python Language
Consensus Network	Mining	Mining	Ripple Protocol	Pluggable: PBFT	Only Parties involved can take decisions	BFT Smart consensus
Privacy	Open	Open	Open	Open to Private	Open to Private	Open to Private
Mining Reward	Yes	Yes	No	N/A	N/A	Yes

IV. APPLICATIONS OF BLOCKCHAIN IN HEALTHCARE

1. Medical Records Management

The recommended Blockchain system [20-25] can be utilized for storing, managing and transferring sensitive medical data in different working localities like hospitals, clinics, and healthcare centers. By using the ethereum network or for more security the modified cryptographic hash generator a highly scalable, immutable and robust system can be produced. All the medical actions such as investigative tests, outpatient stopovers or prescriptions can be symbolized as transactions on the blockchain.

2. Organ Donation Use case using Block chain

The use of block chain technology in healthcare systems is increasing anonymously nowadays. Fig: 8 Organ donation use case using blockchain technology. The process (Figure-8) started with the donor insignia a smart interaction for organ donation and the patient/Receipt file an appeal for resettling. The sequence diagram (Fig-8) below shows the interactions among all the stakeholders/entities of the Organ donation system using block chain secures and distributed platforms. Hash classification competences of block chain technology. The confirmed coordinated pair when broadcast to block chain then this act converted unchallengeable and henceforth provide altogether the elaborate parties the integrity, security, and surety of accessible evidence. The health component at this time can turn as a driller.

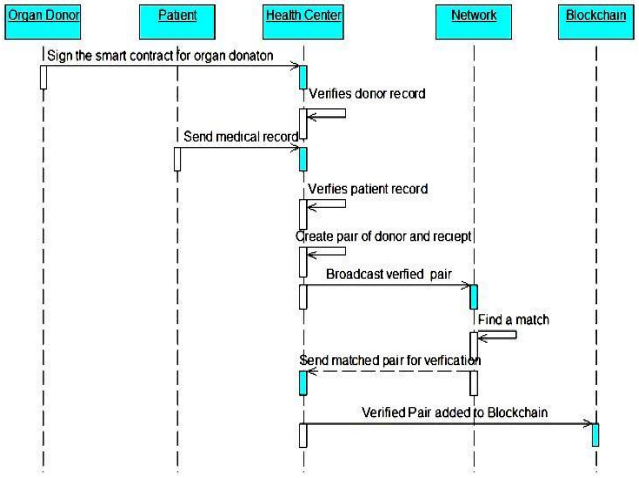

Figure 7 Workflow of Blockchain

3. Drug Traceability in supply chain

Security, one of the chief specific of blockchain is to ensure the traceability and authenticity of the product, only the trusted manufacturer companies should access and record produce on the blockchain, to prove the authenticity of any product. The miners could be manufacturers, distributors or customers as decoded by manufacturing companies. Each actor/entity could have different rights according to their position in the process. Manufacturer companies can register product whereas distributors can only verify transactions. (Figure: 10).

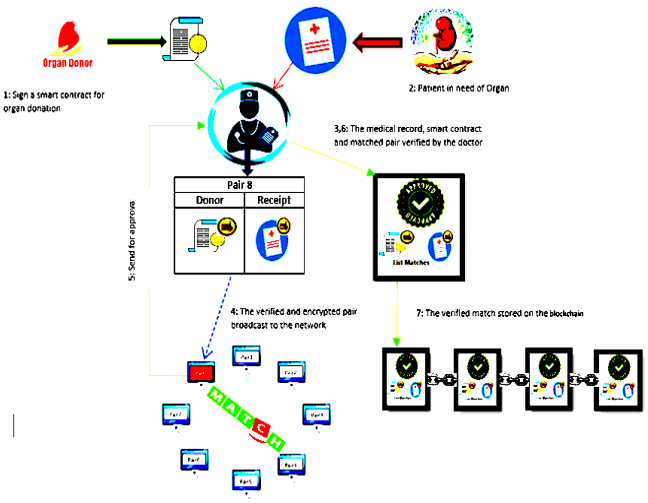

Figure 8 Sequence Diagram for Organ Donation system

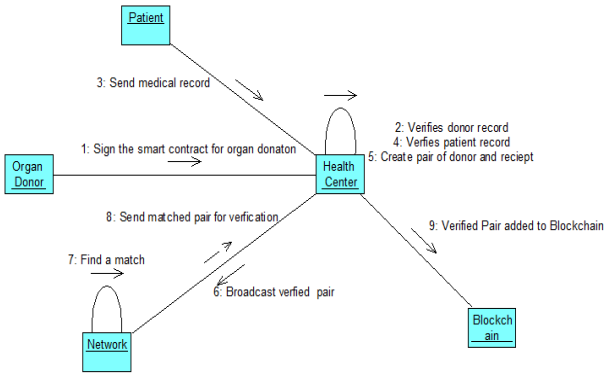

Figure: 9 Collaboration diagram for Organ Donation System

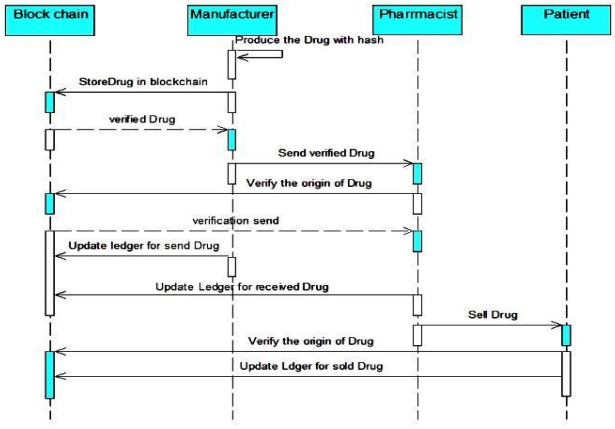

Figure 10 Drug traceability in the supply chain

4. Patient Payments Through Cryptocurrencies

Blockchain technology can play a vital role in the medical payment network, consents a fully transparent, immutable, traceable and everlasting record of all transactions in the blockchain. Cryptocurrency can be utilized effectively in medical billing service, serving both patients for easy and secure payments of treatments with tokens and rewards the competent doctors with cryptocurrency by medical insurance companies. The basic programming structure of blockchain technology makes cryptocurrency secure and authentic means of payment. Cryptocurrency supports all stakeholders and comes as an appropriate and tactful way for all type of transactions

V. ASSISTANCES OF USING BLOCKCHAIN EXPERTISE IN HEALTHCARE

The distinguished properties of blockchain technology like distributed network, shared ledger and digital transaction make it very suitable to be used in the healthcare industry in a number of ways, and get ultimate benefits in different aspects.

a. Extracting the useful information:

By using blockchain technology, monitoring bodies can generate a shared ledger of anonym zed patient information. This data will benefit establishments to identify the epidemics or threats so they can take obligatory measures to control or mitigate the problem in a suitable manner.

.Effective and Budget Control:

Shares access to the information by utilizing the Blockchain technology help healthcare providers to track the data effectively with more powerful security provisions. The third parties can be removed from the healthcare supply chain and the processing of the medical bills which can reduce the overall administrative and audit costs. Blockchain technology keeps the budget under control by dividing the processes into different phases.

b. Medical data Protection:

By the use of time-stamping, encryption and digital signatures blockchain are safe. This enables a protected means of managing and storing all sorts of information, including personal data. Because of the decentralized nature of blockchain technology the risk of data leakage also reduces. The patient's information cannot be accessible by unauthorized individuals.

c. Powerful monitoring:

In blockchain technology, the medical transactions are documented in a decentralized record. It brings transparency and enhances precision. Each new addition needs a complete census to become the part of this data that enhances the monitoring power of the system while at the same time tradable the essential resources like costs, time and efforts.

d. Simplified Claim Processing:

Blockchain technology works on a validation-based exchange which can simplify the process of complicated medical billing and hence eliminate the influence of multiple third parties and series of validations. With the help of the network agreed upon contract, the claims can be automatically verified.

e. Patient self-Generated Data:

By the use of blockchain technology patients have full control over their medical information, they can easily Block chained the information and have the secure and latest medical record available at any time.

f. Managed Consensus:

The healthcare authorities can specifically authorize any individual to access the medical information by the use of consensus that is one of the main characteristics of blockchain technology.

g. Better Collaboration:

The distributed ledger technology promotes the invention in the medical field by providing a shared platform to the main participants i.e. Healthcare professionals, researchers, patients to cooperate and assembly research.

h. Translucent and systematized procedures

Blockchain technology provides incorporated healthcare evidence but likewise keeps noticeable archives of disseminated data and effort. Besides, the hash key access strongly eliminates the probabilities of crucial data leakage. The origin of drug tracking is one of the main advantages of using the blockchain in healthcare systems, the crusade of the drug since the manufacturer to the patient. Separately from safeguarding sensible stock it also removes the probabilities of forging.

VI. CONCLUSION AND FUTURE WORK

In this research work, we introduced Blockchain with its architecture and related literature. Its application is studied especially with respect to the medical field such as medical record management, organ donation, drug traceability, and patient payment details. Which gives great effect and change to avoid organ theft and abuse especially in third world countries. In the future, just its implantation in all medical practices is required which is a costly project on time and budget scale.

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