

Blockchain Technology:

A survey on Applications beyond Cryptocurrency

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Abstract

In the hyper-connected world, data has been playing a significant role in earthing the system of every domain that one can think of. But, it is undeniable fact that today data has prone to serious threats as it was never before, which has questioned the reliability, integrity as well as security of data. So, the technology has emerged that can mitigate all these issues, and that technology is none other than the technology residing at the heart of Bitcoin, The Blockchain.

Blockchain is one of the powerful technologies that has brought a revolution in conventional trading techniques. Conceptually, it is an open and distributed ledger that maintains an irrefutable database of records of all transactions or values that have been executed and shared peer-to-peer directly obsoleting the need for trust-worthy intermediary in a secure, verifiable, moreover, in a permanent way alleviating the risk of fraud.

The main objective of this paper is not only to make blockchain a common business trading language but also to present its compelling applications in contrasting domains that are beyond currency rides, specifically in healthcare, politics, and its strategic implications in bridging strong economy using smart contracts that can revolutionize our digital global village.

Keywords:

Bitcoin, Blockchain, Open-Ledger, miners, healthcare, supply chain, smart contracts.

Introduction

Originally developed in the year 1991 by a group of researchers to timestamp digital documents to make it impossible to temper them, the blockchain paradigm a peer-to-peer network that sits on top of the internet, was reintroduced in October 2008 as a part of a proposal for bitcoin, a virtual currency system that has ended the concept of a central authority for issuing currency, transferring ownership, and confirming the transactions. [12]

A blockchain has attempted to solve one of the biggest problems, i.e. a monetary transaction by using distinct principles:

1. Open Ledger

One of the most unique features that outstand this innovation among other innovations is an immutable, distributed open and public ledger, which is a chain of blocks that holds each transaction that has been made and each transaction is validated by all the participating entities.

2. Peer-to-Peer transaction

In the blockchain, communication between peers occurs directly instead of through a central entity. For example, to do a monetary transaction between two entities, an intermediary such as a central bank is required, but in blockchain, it happens directly between the participating nodes. Additionally, each node keeps a record of the transaction that has been done in the ledger.

3. Distributed System

To provide a concrete security land for trading, blockchain manages the ledger in a distributed system by maintaining the record of each transaction across the nodes in the network which means everyone in the network can access the chain of events that happened in the network.

4. Transparency with pseudonymity

Every transaction that has been happening in the ledger and its associated value are visible to everyone who participated in the network. Each user on a blockchain is provided with a unique alphanumeric address known as a hash for identification. Moreover, users can choose to remain anonymous or provide proof of their identity.[11]

5. Miners

After maintaining a distributed system, another problem that came out was synchronizing the ledger which is cured by using the concept of miners –**the special nodes that validate the unvalidated transaction and add it to the ledger by investing the computational logic as needed as the time to find the random key to take the previous transactions to lock the new transaction.** The miners who make the first move of validating and adding the transaction to the ledger get the financial incentive, in terms of cryptocurrency like bitcoin.

6. Proof-of-work

Once a block of the transaction is recorded in the ledger, it cannot be altered, because each transaction is linked to every other transaction that came before them. Each

block of the transaction consists of data, a hash (unique identification property), and a hash of the previous block. It's easy to temper the information inside the blocks by changing hashes, to mitigate this problem, the more secure concept of "Proof-of-work" is used, which is a mechanism that slows down the creation of new blocks alleviating counterfeiting and fraud.

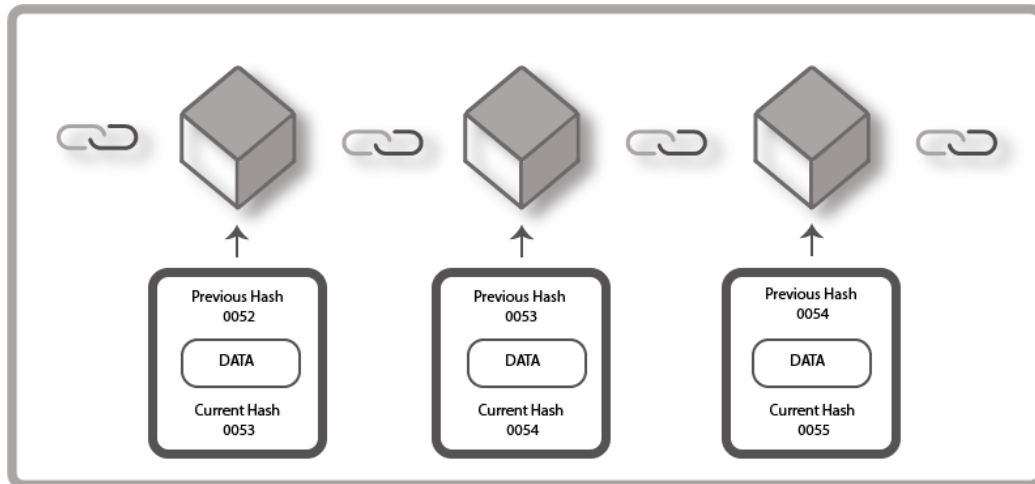


Figure 1: Blockchain's proof of work[16].

The decentralized consensus and anonymity are the most significant characteristics of blockchain technology [6]. Many industrial players such as IBM, Microsoft, and Intel are currently investing in this fast-growing technology [6]. However, there is rigidity in the structure of this technology that does not accommodate real-life scenarios.

Blockchain-injected domains

Blockchain in healthcare:

It is an irrefutable truth that approximately most of the mis-happenings in healthcare have been occurred due to the misidentification of patients as well as missing patient information. This happens because of accidental or deliberate counterfeiting in the records of patients which leads to severe damage to the life of patients. So blockchain has revolutionized the way of storing a vast number of patient records by assigning the consensus mechanism and cryptography for verification. Additionally, to maintain the reliability of records, blockchain offers the hashing mechanism known as proof of work, which eliminates the risk of temperament in digitized records. In today's high-populated digitized era, there is a massive number of electronic records of patients in healthcare and such growth tends to pose protection of data while using and sharing [1].

The advent of blockchain technology as a responsible and transparent mechanism to keep and distribute data is creating the path for new potentials for solving serious data-related issues in healthcare such as privacy, security, sharing, and integrity. The distributed architecture of blockchain ensures that data in the ledger is processed in decentralized venues, making it accessible as well as accountable to all users present in the network, minimizing the amount of medical practice and monitoring, and gaining more control over health records and patient care [1]. Blockchain also facilitates patients to keep a check on their health records added in the ledger enabled by transparency in the network of blockchain technology.

The potential of blockchain can also be seen in the lengthy and complex supply chain of healthcare. Supply chain management is a challenging prospect with a lot of complicated networking structures such as scattered ordering settings of medical supplies, drugs, and critical resources, so there is an inherent risk of compromising the supply chain process that endangers a patient's life [14]. Blockchain technology, being credible in nature, promises the eradication of falsified drug supply that could directly impact patient safety [1].

Blockchain uses a mechanism that has the potential to innovate in preventative care and community-based healthcare models [11]. The capacity of a distributed ledger technology could ensure data integrity as well as reliability while sharing among parties which can lead to assured collaboration between growing trends in healthcare, which are crucial for the improvement of health in communities globally [11].

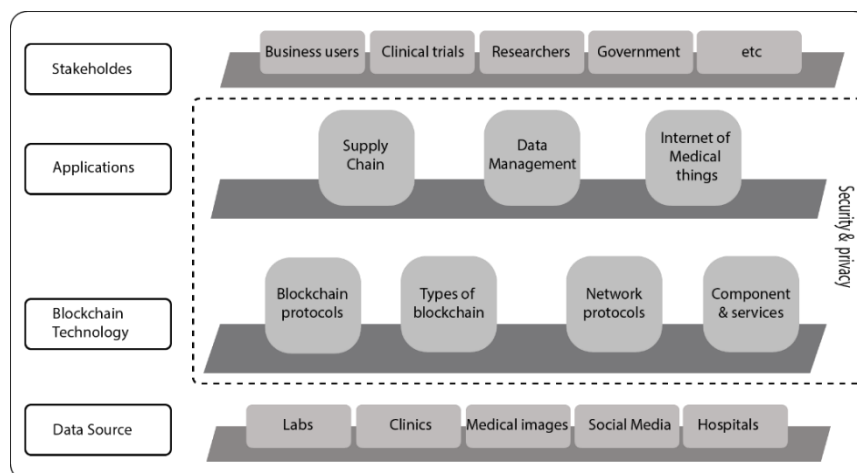


Figure 2: Blockchain in the Healthcare domain [1]

Blockchain in Strengthening Economies:

Smart contracts: One of the emerging applications of blockchain is smart contracts. Smart contracts are simple computer transaction protocols that automatically execute when pre-configured conditions or terms in a contract among disparate, anonymous participating entities are met. After exhibiting the predetermined conditions, the involved parties are legally binding mutual agreements that can be automatically made payment as per the contract in a transparent manner without involving an intermediary [13]. However, if the conditions fail to meet, the payment automatically goes back to the entities. These contracts resolve the issues encountered in traditional contracts by offering efficiency, accuracy, and immutability.

Smart contracts can be applied in various domains such as Banks that can use them to issue loans to offer automatic payments, Insurance companies could use them to process certain claims, moreover, postal companies can use them for payment on delivery. However, some security issues also exist in which an adversary can manipulate a contract's execution to gain profit [6].

There is a handful of blockchains that uses smart contracts but the biggest one is "Ethereum". It was specifically created and designed to support smart contracts. The language that is used to program smart contracts is called Solidity.

Blockchain in Elections:

Voting system: Voting is a fundamental right of people in democratic nations where they elect government leaders of their choice. Whereas, the traditional method of voting through paper balloting is prone to errors, as it is a tedious as well as time-consuming task to count the number of votes by hand, more often than not, malicious actors have many avenues to influence paper ballot elections whether by using intimidation tactics at the ballot boxes or just stuffing the boxes with forge votes, so this old method of voting puts the integrity and reliability of elections under doubt.

To counter the security problems of paper balloting, digital voting systems using electronic voting machines (EVM) came to the light. Nevertheless, EVM also suffers from security concerns as it is so simple to inject any malware into the device that will mess with the server [9]. However, the voting system must be legitimate, accurate, safe, and convenient when used for election so that deserving candidates can lead the world [8].

Blockchain technology came into force to mitigate these issues by offering end-to-end verification advantages [3]. With blockchain voting, the election process is made as transparent as possible by removing the intermediary entity, here the election commission, which revolutionizes the entire voting system. In this technology, when the voter cast their vote for any party, then that vote cannot be tempered as well as they can keep track of it using the decentralization feature of blockchain. The first election underlying blockchain technology happened in Sierra Leone, Africa.

So, this powerful technology provides the opportunity for unaltered voting, transparency, increased online accessibility, and more organized voting operations [3].

Conclusion:

Blockchain can promise wonders in the future by indulging in rich domains that could revolutionize the whole digital world. One of the possible blockchain applications that are under work is renewable electricity production using the next generation distributed smart grid technology effectively and this can be proven as one of the crucial use cases that are possible using blockchain. There are many other domains, where blockchain can show up at its full potential such as cyber security, digital advertising, and many other fields.

This paper summarizes the most crucial applications of blockchain including smart contracts, voting systems, supply chain management, and healthcare. There is possibly an infinite number of use cases of blockchain technology that will hold the trust of people.

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