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Uses of Blockchain Technology in Libraries

Aman Kumar Jagdev[1], Anil Kumar Dhiman[2]

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Authors Affiliation:
[1]B Tech III-Year Student, Graphic Era (Deemed to be University), Dehradun 249001 Uttarakhand, [2]Information Scientist, Gurukul Kangri (Deemed to be University), Haridwar 249404, Uttarakhand, India.

Corresponding Author:
Anil Kumar Dhiman, Information Scientist Gurukul Kangri (Deemed to be University), Haridwar 249404 Uttarakhand, India.
Email: akvishvakarma@rediffmail.com

Abstract

Blockchain that is known as the distributed database of records or public ledgers of all transactions or digital events conducted and shared by participants/nodes is a relatively young technology. However, cryptocurrency was first to adopt this technology. Since then, it is being used in many of the fields. The notion of blockchain technology and its applications in library services are discussed in this article.

Keywords: Blockchain; Distributed Database; Libraries.

Introduction

It has been noted that almost over a decade ago in 2008, Satoshi Nakamoto, the anonymous creator of Bitcoin, explained how blockchain technology, a distributed peer to peer linked structure, might be used to solve the problem of transaction order and avoid double spending (Nakamoto, 2008). According to Nakamoto, bitcoin organises transactions into constrained size structures called blocks with the same timestamp, and the network's nodes as in charge of connecting the blocks in chronological order, with each block carrying the hash of the preceding block to form a blockchain (Crosby et al., 2016). Blockchain structure can keep a reliable and auditable record of all transactions. Hoy (2017) also says that blockchain serves as a primary mechanism for Bitcoin's operation as well as the fundamental operations of many other technologies.

So blockchain is a decentralized or distributed database that comprises of multiple devices but not to a common processor and organize data into blocks or records which have cryptographic validation. They are timestamped and are linked to previous records so that they can only be changed by those who own the encryption keys to write that fields.

Since 2008, various developments took place in this field. Table 1 (based on Hassan et al, 2020) gives an idea about the evolution and development of blockchain technology.

Table 1: Evolution and Development of Blockchain Technology.

Year	Events
2008	Bitcoin's whitepaper was published by Satoshi.
2009	First Bitcoin block was created.
2010	First Bitcoin cryptocurrency exchange Mt. Gox started working.
2011	Silk Road launched with Bitcoin as payment method. Bit Pay was first Blockchain-based wallet. Emergence of other cryptocurrencies like Swiftcoin, Litecoin.
2012	Coinbase, started as brokerage for Bitcoin.
2013	Ethereum, a blockchain-based distributed computing platform was proposed.
2014	With crowdfunding the Ethereum Project was started. Ethereum genesis block was created.
2015	Blockchain trial was initiated by NASDAQ. Hyperledger project was started.
2016	Ethereum DAO code was compromised and hacked. Emergence of permissioned blockchain solutions.
2017	Seven European banks, announced their program to develop a blockchain-based trade finance platform in collaboration with IBM.
2018	Blockchains potential got revamped by more investments in wide range of use cases.

Today, blockchain offers a wide range of applications in various fields, including higher education, the arts, health, science, literacy, medicine, and more (Chen, Xu, Lu and Chen, 2018).

Overview of Blockchain

A blockchain is essentially a digital log of transactions that is copied and distributed throughout the blockchain's complete network of computer systems. It stores data in such a manner that it is difficult or impossible to alter, hack, or defraud it. It is a form of distributed ledger technology in which transactions are recorded using a hash, which is an immutable cryptographic signature. Each block on the chain comprises of a number of transactions, and each time a new transaction takes place on the blockchain, a record of that transaction is added to the ledger of each participant.

Simply saying, a blockchain is a distributed append only timestamped data structure that enable us to create a distributed peer to peer network in which non-trusting individuals can communicate with each other in a verifiable manner without the use of a trusted authority. To do so, think of blockchain as a collection of interconnected processes that provide particular features to the infrastructure, as shown in Figure 1 (Source: Casino et al., 2019). Each component based on Casino et al (2019) is detailed out below:

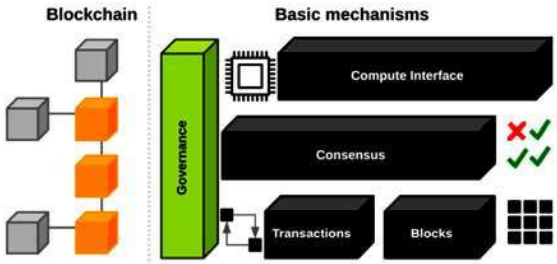

Fig. 1: An Overview of Blockchain Architecture

It should be emphasised that signed transactions between peers, which signify an agreement between two participants and may entail the transfer of real or digital assets, the execution of a task, and so on, are at the lowest level of this infrastructure. This transaction, however, is signed by at least one participant and broadcast to its neighbours. Any entity that connects to the blockchain is referred to as a node. Full nodes, on the other hand, are nodes that validate all of the blockchain rules which organise the transactions into blocks and are in charge of determining which transactions are genuine and should be included in the blockchain and which are not.The second layer is consensus, which may take many forms, but the most popular is PoW (Proof of Work), which entails solving a complex computational task, such as discovering hashes with certain patterns, to assure authentication and verifiability. Rather than dividing blocks proportionately to miners' respective hash rates, PoW divides stake blocks proportionately to miners' current wealth, making the selection process fairer and preventing the network's wealthiest player from controlling it. However, PoS (Proof of Stake) and DPoS (Delegated Proof of Stake) are also there where selection of each round of node who creates a new block depends on the held stake rather than the computational power; and they make the stakeholders give the right of creating blocks to the delegates they support instead of creating blocks themselves respectively (Zhang and Lee, 2020).

The other layer that allows blockchains to offer greater functionality is the Compute Interface. It should be noted that a blockchain effectively stores a state consisting; for example, of all the transactions made by users, allowing for the calculation of each user's balance. However, for more advanced applications, complex states that are updated dynamically using distributed computing are required. SCs, which employ blockchain nodes to execute contract conditions, have arisen as a result of this necessity.

Finally, there's the Governance layer, which broadens the blockchain architecture to include human interactions in the real world. Though, blockchain protocols are fully defined, yet they are also influenced by contributions from a variety of people who incorporate new methods, enhance blockchain protocols, and repair the system. These components, however, are required for the evolution of any blockchain. Thus, blockchain governance is concerned with how these many players collaborate to create, maintain, or alter the inputs that comprise a blockchain.

Characteristics of Blockchain

Blockchain bears many characteristics. But Sanjay and Hasan (2020) have assigned following important characteristics to blockchain:

Validation/Consensus

Validation means the miners that solved the puzzle are rewarded and the block is distributed through the network. There are many types of consensus algorithms to validate a block into a chain like: Proof of Work (POW), Proof of Stack

(POS), Proof of capacity, Proof of elapsed time, etc.

Immutable

Block once added in a blockchain, it becomes impossible to delete it or modify it. Because a small change in the block could lead to a new block with a new hash.

Replicate/ Peer-Peer Network

Blockchain uses a distributed network that is termed as a public ledger in which every node/ participant has a copy of each transaction.

Transparency

Full transparency is there because all transactions are visible to everyone, and all participants know about who performs what action, at what time by themselves.

Secure

All the data are stored in many computers and there is no central authority. So, hacking of every node in the network at the same time is quite impossible and costly. Hence, blockchain technology seems to be more secure.

Smart Contracts

It is peace of code which contain specific terms and conditions. A set of conditions are made for the operation of smart contracts to which all users agree (Christidis and Devetsikiotis, 2016), whenever these conditions are satisfied, automatically the terms of the agreement are carried out.

Uses of Blockchain

The finest application of blockchains may be observed in the banking industry, where banks can collaborate and push their clients' transactions over the same blockchain. Beyond transparency, blockchain allows transaction audits in this way (Casino et al, 2019). Due to its popularity, the blockchain technology is becoming increasingly relevant (Zhao et al., 2016) and around 1000 of C-suite executives declare that they are considering or have already been actively engaged with blockchains (IBM, 2017). Further, the researchers and developers are already aware of the capabilities of the new technology and explore various applications across a vast array of sectors (Christidis and Devetsikiotis, 2016).

Today, its searches have many applications in other areas. The transition from blockchain 1.0 to blockchain 3.0 will deploy blockchain applications primarily in college, arts, health, science, literacy, medicine and more (Chen, Xu, Lu and Chen, 2018). Blockchain can also be a useful answer to a variety of difficulties that universities face, and it can be used for a variety of activities such as certification, monitoring, verification, and sharing, among others.

Barriers in Using Blockchain Technology

Inspite of various applications of blockchain technology, there remain several obstacles to overcome. There are several problems and issues, such as how to build an acceptable consensus procedure. Furthermore, blockchain consensus is a big issue, as all nodes must maintain the same distributed ledger. Due to the presence of the centre server in conventional software design, however, consensus is seldom a problem. But the other nodes must only be aligned with the server (Zhang and Lee, 2020). However, in a distributed network like blockchain, each node serves as both a host and a server, and it must communicate with other nodes in order to achieve a consensus.

Zhang and Lee go on to say that certain nodes will go down or offline at times, and that there will be malevolent nodes that will significantly disrupt or ruin the consensus process. Only a good consensus procedure can withstand these occurrences and reduce the impact so that the ultimate consensus outcome is unaffected. Similarly, the consensus process utilised by the system must be compatible with the blockchain type being employed. There are available public blockchains, consortium blockchains, and private blockchains, each with its own set of applications. But, the consensus protocol chosen must meet the requirements of each application scenario.

Uses of Blockchain Technology in Libraries

Though, the concept for the use of blockchain in libraries is in its initial stage and its utility is yet to be proved. But this technology has the potential to enhance the role played by libraries within their communities. Sanjay and Hasan (2020) has listed various areas where blockchain technology can be applied: digital rights management, plagiarism, payments, users to user loan, interlibrary loan, and scholarly publishing. Figure 2 based (https://tinyurl.com/fxms92tw) also explains these areas well.

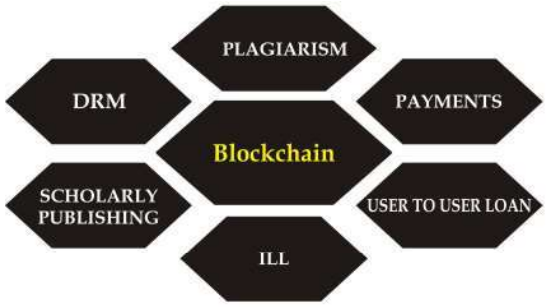

Fig. 2: Various Areas of Application of Blockchain in Libraries.

However, more elaborately Fakiragoudar (2021) has listed the following possible uses of this technology in libraries.

Building a Metadata System for Libraries

This technique can be used to solve inventory centralization and traceability issues when the library starts creating permissions without the metadata blockchain to get around some categorical restrictions. First, this process is to generate a public and private key and then these keys are managed using digital wallet software. Then, other genesis blocks are created and later new or changed blocks are created. Records are sent as blocks by nodes for verification according to a consensus algorithm. Only the top level node is needed to store a copy of the entire blockchain, and other organizations can decide whether to use the short version or the full version.

Protecting Digital First Sale Right

Library may secure the right of a first digital sale where an online blog providing a way to buy and rent the e-books using decent blockchain can be created. Channel creators can decide whether to allow other channel members to preview their work early on with permission, or others can borrow unlimitedly or without paying unnecessarily high fees.

Connecting the Network of Libraries

Blockchain may allow the digital information to be distributed rather than simply copied. So, the information is continuously shared and coordinated among multiple nodes, with each node holding the same copy of the database as evidence. Though the transactions in this database have been audited and agreed upon by consensus but the public ledger has virtually no control over a single entity with this distributed change tracking method. So, there is the possibility of eliminating even a single error and enabling transaction validation without the need for a single transaction.

Conclusion

Summing up, it can be said that Blockchain technology is one of the present day library era developments that lists the records called blocks which save information publicly and in chronological order ensuring that the facts are encrypted using cryptography to ensure that the privacy of the user is not always compromised and facts cannot be altered. Because of this truth blockchain has the notable capacity in modern-day libraries is simple (Chen et al., 2018).

However, in future, blockchainis expected to be used by the users to discover the report changes and save the records tampering. But the librarians and other staff have to take a look at the structures and tactics currently in use to peer whether or not they will pay blockchain. Still, this is a vast and untapped area of study that has both challenges and opportunities to the upcoming educators, researchers and developers (Vysakh and Rejendra Babu, 2020). Never the less, the technology will be more visible in libraries as many of the libraries globally have started working on how to harness these in libraries and hoped this technology will become more not unusual in libraries, and as such many libraries round the world have commenced to analyse ways to use it.

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