

Overview of Blockchain's Application: Advantages and Disadvantages

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Abstract—The Blockchains concept has recently emerged as an important area of research. Blockchains are records in the form of a list, where each record is linked with the other by cryptographic techniques. Blockchain has been popular because of its decentralized, peer-to-peer transaction and immutable properties. It is a shared digital ledger available to all nodes or users present in the public or the private peer-to-peer network. The Blockchain enables a fully decentralized system which has been an important feature because of which no one can control the operations on it. It is an open form of distributed ledger which records all transactions carried on it by all parties.

In this paper, we are presenting a systematic overview of working of Blockchain technology which is mainly focused on introduction, types, and basic design elements along with its applications such as currency, smart contracts, digital voting, supply chain management, healthcare services. Each application of blockchain has been critically reviewed and advantages along with shortcoming of each application has been discussed.

Index Terms— Blockchain, Applications, Smart contracts, Digital voting, and Supply chain management.

I. INTRODUCTION

Blockchains are records in the form of a list, where each record is linked with the other by cryptographic techniques. In Blockchain the block contains the Block header and transaction data. Since all blocks are cryptographically connected, modification of the data becomes impossible [1]. The block header consists of four important parts such as previous block information, associated timestamp with it, nonce, and Merkle tree root's hash. In a blockchain, every block is identified by a hash value generated by the SHA256 cryptographic hash algorithm. Each block contains the hash of its parent inside its header. In this way, it creates long sequences of hashes that link every block with the parent block, where each block has a single parent, but a single block may have several children [2, 3].

The hash value of the previous block is used for creating the hash value of the current block, a consensus algorithm is used for calculating the root value of transaction T and nonce. The detailed information of the block is stored in Timestamp which has a size of 4 bytes. The Nonce is a number used only once to generate. In this field, 32 or 64-bit integers are stored that are used in the mining process. The detailed summary of every transaction is contained in a Merkle tree. The integrity of such a large data set is summarized and verified by using the Merkle tree which is also referred to as binary hash tree [2]. For the sake of identification and verification of transactions, the root of the Merkle tree plays an important role. The Merkle tree can store the

children's node information up to a size of a gigabyte. After comparing hash, transaction data is verified using authentication path while the transaction value is generated by Ralph Merkle's algorithm [4,5,6]. In the blockchain, the operation such as edit, modifying and deletion of block is impossible after transaction is confirmed.

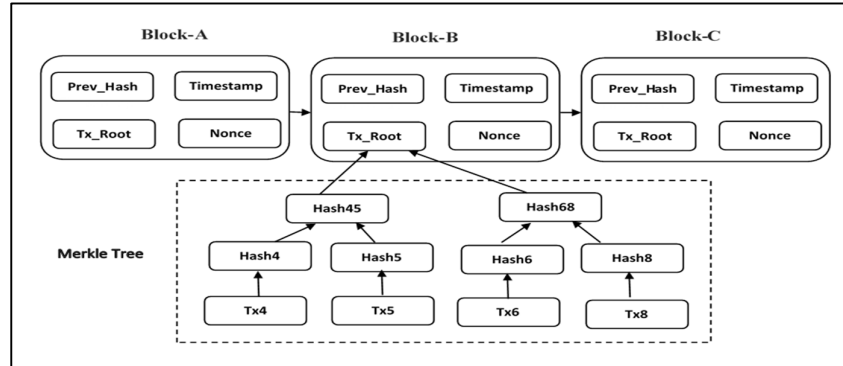


Figure 1: Basic Structure of Blockchain

Figure-1 represents the structure of three blocks Block-A, B, and C which are forming a chain of blocks called Blockchain. Block-B represents Transaction root, and contains Hash45 and hash68 along with Transaction root labeled as 'Merkle tree'.

Satoshi Nakamoto first introduces the Blockchain concept, for solving double-spending problems in electronic transactions [3,4]. Blockchain is also called a distributed digital ledger which is immutable and secured with cryptographic techniques. The peer nodes are imitated by consensus in a peer-to-peer network for transaction log that is controlled in a decentralized fashion [4,7].

This paper intends to provide a complete overview of blockchain applications. This paper is organized as Types of Blockchain. It is then followed by the Application of Blockchains such as Digital Currency, Smart Contracts, Digital voting, Supply Chain Management, Copy Rights, Digital Identity, Property Title Registries and Blockchain in Healthcare. The next section is Related work which is followed by the conclusion and references.

II. TYPES OF BLOCKCHAIN

The Blockchain is classified into two main categories as Permissionless and Permissioned blockchains.

In Permissionless blockchains there are no restrictions on its nodes, where anybody can read and examine data openly. The validation of written data can be performed by using the consensus protocol. The permissionless blockchains are fully decentralized, transparent, and secured with cryptographic techniques. The transactions in Permissionless blockchains cannot be changed on the node once it is confirmed. The permission-less blockchains have another type called public blockchains in which the ledgers are visible to anybody. On Internet, anybody can examine it and can add a block of transactions to it. Bitcoin and Ethereum are two cryptocurrencies that are executed in public blockchain [4, 8].

The Permissioned Blockchains can be accessed or written by a limited group of authorized participants. The consensus algorithm is used for the validation of data written by the authorized participants. The Business and Social applications mainly used permissioned blockchains [4].

Depending on the authorized permissions, Permissioned Blockchains are open and closed in nature. In Open Permissioned Blockchains data can be read by anyone who has been authorized to write data in the blockchain, this type of blockchain is considered partially decentralized. In Closed permissioned blockchains, only participants' data are visible, this type of blockchain is considered fully centralized and not transparent to another participant. The permissioned Blockchains are consortium blockchains and private blockchains [4, 8].

In Consortium blockchains only particular organization groups such as banks can verify and add a transaction on blockchain but, the ledger could open or be restricted on the selected group [4, 8]. The Consortium blockchains are classified as R3 and Corda. While, in Private Blockchains only authorized persons can inspect and add transaction blocks but, on the internet all persons are permissioned to view the transaction. The private blockchain is classified as Monax and Multichain [8].

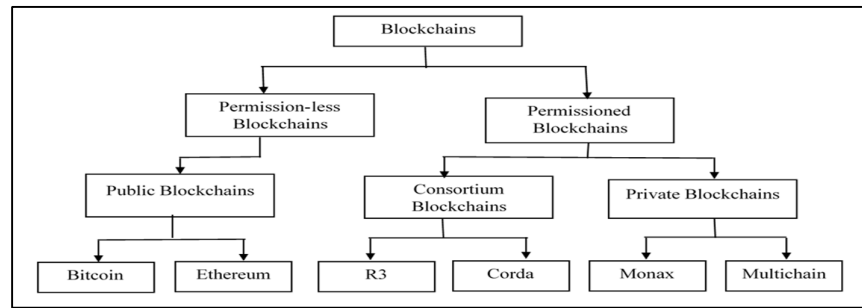


Figure 2: Types of Blockchains

III. APPLICATIONS OF BLOCKCHAINS

The following section describes the applications of blockchains along with advantages and disadvantages of each application in detail.

A. Digital Currency

By introducing Bitcoin, decentralized digital currency came into existence it is called the founding application of blockchain technology. Coins and tokens are two types of cryptocurrencies that are based on Blockchain [3]. The payment can be made by exchanging Bitcoins between two participants without the involvement of any third party or even without using different forms of currency [3,4]. The Bitcoin, Ethereum, Bitcoin Cash, EOS, Ripple, Litecoin, Tether, Binance Coin, Bitcoin SV, and Stellar are some currencies based on blockchain [3,4]. Some countries such as USA, Canada, Netherlands, and South Korea these countries which has started the payment method using Bitcoin.

Advantages: Using Cryptocurrencies two participants can directly exchange or can-do payment without involving a third party, without intermediaries which provide the transparency, security of the transaction. Some central bank has considered Cryptocurrencies as an external asset. Government by using Cryptocurrencies to control the currency value.

Disadvantage: The criminal activities or scam/attack are increased day by day in bitcoin and other cryptocurrencies has not clear view about the monitoring status or support of the cryptocurrencies [9]. Blockchain is used in distributed nature, operation of the blockchain are encryption and complexity, as compared to traditional payment such as cash and debit card, the blockchain transaction speed is slow and cumbersome.

Now a days researchers focus on blockchain security and how to fast the transaction speed, the various security applications and tools are developed such as Oyente, Remix, Gasper, Securify, S Analysis, Smartcheck and Mythril [10].

B. Smart Contracts

An American cryptographer Nick Szabo has introduced Smart Contract in 1990, but the practical applications of smart contracts started after widespread use of blockchain in 2008 [11]. The smart contract is implemented on blockchain where validation is executed automatically. Using smart contracts money, property, shares can be exchanged. The smart contract which is developed using serpent, Low Level Lisp like Language, and solidity can be executed using Ethereum Virtual Machine (EVM) [11,12]. In Blockchain technology the Ethereum is first platform that specially developed to decentralized applications and smart contract run.

Using smart contract insurance company to verification or validate the client claims and provide the calculation of a payment.

Advantages: Smart contract is written in a computer form that is executed automatically without using third party, there is no need of lawyer or intermediaries, its effect to saving money, fraud reduction, manually felling errors are avoided in smart contracts, as Compared to traditional contract the smart contract are cheaper and faster.

Disadvantages: Smart contract specially develop on the solidity language, Lack of awareness about smart contract, what is smart contract, how to execute smart contract and smart contract uncertain legal status in many countries. Smart contract flexibility is low as compare the traditional contract.

Blockchain developer will require to provide the platform of services, tools and user-friendly interfaces for minimum required of technical expert.

C. Digital Voting

The process of voting that use paper or electronics voting for computer that used special software. Cost of paper voting process is high. Electronic voting is not secure because hacker can hack the machine and tampered with their votes. Recently many countries have started using blockchain technology to cast and store the votes. Using Blockchain technology the system is transparent, everybody can verify the voting counting and its very difficult to tampering voting. The Agora of Swiss company to working on this system for open source.

Digital voting based on Blockchain is executed on open permissioned blockchain. In the midterm elections held in West Virginia, US, in 2018, the mobile voting project was used, using which the military persons and their family members were able to cast their votes. The blockchain server with distributed nature was used in this project [4, 12, 13].

Advantages: Blockchain-based digital voting systems would ensure voter confidentiality and transparency. Fast result of Blockchain based digital voting and useful for military/army person and front worker for cast their vote.

Disadvantages: On Internet many hackers or attackers will be hack the system and social privacy issue will occur. How to identify the voters, In digital voting, if allow the people to vote on their self-computers, laptop, mobile, then hacker, attacker to hack the user computers or malware that infected to user's computer, that affect the tampering voting process.

In digital voting system process may not be allow the people to vote on their own computer or devices, The blockchain with the help of IOT and other smart technologies to identify the voters with thumb impression or face recognition to solve the privacy issues.

D. Supply Chain Management (SCM)

By using blockchain technology in supply chain management, costs could be reduced which will remove the intermediaries or third parties which would increase the trust between sellers and buyers. Recently, Walmart has been using blockchain technology, to remove intermediaries between buyers and sellers which have increased the degree of transparency in transactions. Due to which buyers can easily track the products [4, 14]. Walmart is developing a blockchain-based supply chain application on the pork market in China in collaboration with IBM and Tsinghua University of Beijing [15, 16]. The report state that, it has become easy to track food items and has enabled effective monitoring for food safety which has increased the trust of customers in the products [16]. In supply chain management use of blockchain technology, IoT technology and new concepts such as sensors, RFID, GPS, barcodes chips have made it easy to track the products and location of goods or product containers within few seconds [4].

Estonia is the first country to develop the KSI blockchain which has established a strong secure network in that country [4, 13].

Advantages: Using the blockchain technology in supply chain management by removing the intermediaries, it effects to transparent process, cost saving, fast processing and time saving. With the help of blockchain technology and use of IOT technology, sensors, GPS, barcodes chips, RFID to easily track the product and location of goods withing few seconds.

Disadvantages: As a new technology of Blockchain the adoption or implementation, training cost is high and not useful for small business or small companies.

Now a days the researchers focus on how to increase the network speed and how to fast the transactions speed and security. In future the blockchain adoption cost may be reduced.

E. Copy Rights

On the internet unauthorized users can copy the data and illegally transfer, share this data on the network. The blockchain technology can be used the Trusted Timestamping and hash function that provide and maintain the copyright ownership. When the data is created, the date and time defined on this data. The Trusted Timestamping the data is store on encoded form. In blockchain use the hash function to provide the security and immutability. The Blockchain technology solve the copyrights problem and to maintain the copyrights ownership [6].

Advantages: In Blockchain technology can maintain the copy rights information, to provide the security of the information and immutability using the trusted timestamping and hash function.

Disadvantages: Due to blockchain technology is new, currently there are not any standards / protocol. Blockchain technology run on internet there are many hackers or malicious users are present, which increases the possibility to hack the node or network. If this happens, then it cannot maintain the copyrights ownership and hackers or unauthorized can easily share documents on internet.

The researcher currently working on blockchain security tools, standards, and protocol, in future they will be develop the blockchain standards and protocol. In blockchain technology to use the advance cryptography, trusted timestamping, and hash function for maintain the security and copyright ownership.

F. Digital Identity

Every country is now focusing on the digital identity. Each sector to utilize the digital identity such as documentation, banking, security, hospital, industry, company. Malicious users or Hacker to misused or hack the digital identity. Blockchain technology to use the advance cryptographic techniques, digital signature for verification of identity, to solve the above problem. In blockchain the information is store on block and this block is secured using by advance cryptographic techniques, there were anyone does not change the information in this block [6].

Advantages: Blockchain technology to use the advance cryptography for secure the digital identity, in this technology ones the data or information are added in the blocks then does not any changes in that block and anyone any time anywhere to view or read the data or documents.

Disadvantages: Sometimes identity is hacked or misused by many unauthorized users. In blockchain technology to use the digital signature for verification the transaction but this is long process, and the transaction speed is also slow.

Blockchain technology uses the advance cryptography and this technology the information is securely stored on the block that easily not modified or hack the information. In blockchain network the transaction process to use the proof-of-stake (PoS) protocols and consensus algorithm that take the minimum time for digital signature verification process.

G. Property Title Registries

Property Title Registry uses the Blockchain technology for store the property title in distributed ledger platform of Blockchain technology. Blockchain technology open nature, to publicly access, verify the records of property with low cost. Benefits of Property Title Registries to use Blockchain technology are transparency, fraud elimination, minimum cost [17, 4].

Advantages: Anyone could publicly inspect the property records on blockchain with minimum cost and time. The open nature of blockchain property title records would also enable developers to come up with new applications providing easier ways for accessing, processing, and inspecting these records. Mainly, fraud elimination, transparency, cost-effectiveness, transfer of rights without third-party notary involvement are the key benefits of a blockchain-based property title registry.

Disadvantages: Due to new technology of blockchain, now a days lack of awareness, how to use the blockchain technology, how to work blockchain technology and the adoption cost is high therefore training cost for new employee is also high. If buyer or seller is illiteracy, then intermediaries or agent will misguide or fraud.

To spread the awareness of blockchain technology in government office, institutions. Each government department or office to train the one employee and after training of this employee to train to others. As a new technology of blockchain, the training cost is high but due to blockchain its many benefits to accept it, in future the adoption of blockchain and training cost will may be reduced.

H. Blockchain in Healthcare

In healthcare by using the blockchain technology many benefits are attained to the patients and healthcare services such as 1] patients' medical history, reports online secure and store, manage their records anywhere anytime and share the medical reports to specialist doctors to anywhere any time. 2] Use Blockchain technology in healthcare service to provide the authentication, confidentiality, and data sharing. 3] Securely collected and store the patient's data and share to doctors or healthcare providers of patients. 4] To maintain the medical records and protect the identity of patients or protect the patients' medical reports integrity. 5] Medical company to uses the blockchain technology to maintain the medical records, documents, audits documents, medicine ownership and management of medicine supply. [18-20, 1].

In 2016, Estonia implemented blockchain to safeguard its national electronic health record system, Patients can log in to give or rescind health records access, Patients can see name and time stamps when their records were accessed by anyone, e-Prescribing, e-Ambulance, e-Identity.

MEDREC this platform is used for handling the medical records electronically and its specially develop for to sharing the medical information, confidentiality, authentication. [18-20, 1].

Advantages: Using blockchain technology it has been easy to manage, accessing, integrating, and sharing securely health records anytime anywhere. Patients keep track of their medical history, that easily check the

latest medical prescriptions and share the information securely to the providers. Medical data and documents are safe, secure in blockchain technology. The Insurance companies are using blockchain technology with smart contracts for billing and claim settlements and to increasing the process in effectiveness of fraud detection and to reduce the administrative cost [1].

Disadvantages: In blockchain technology currently there is not any government rules and regulations for e-healthcare system. Now a days number of patients are increasing this very difficult and challenging task to maintain patients' information in an e-healthcare system, that effects to storage issue will occur.

Blockchain technology user will store the data on cloud storage technology that will solve the storage issue.

IV. RELATED WORK

A. Kiayias et al (2015) have described the Segwit application, this applications parallel run with Blockchain network. Signature data moves from the main Blockchain system to the extended sidechain [21].

Karame, G et al (2016) have develop the Oyente application. This application is used for to detect the bugs on Ethereum contracts [22].

F. Idelberger et al. (2016) have described The Lightning network application, in this application to create the transaction receipts with double signed [23].

Mehrdokht Pournader et al (2020) Blockchain applications in supply chains, transport and logistics: a systematic review of the literature, has presented the Blockchain applications in supply chains, logistics and transportation [24].

Yan Xu et al(2020), "Application of blockchain technology in food safety control:current trends and future prospects", author have proposed the framework applications of blockchain technology in food safety control [25].

Shuyi Pu et al (2020), "Blockchain adoptions in the maritime industry: a conceptual framework", has present the Blockchain applications from different maritime sectors and to developed the framework of blockchain to use in the industry [26].

Kichan Nam et al (2019)," Blockchain technology for smart city and smart tourism: latest trends and challenges, Asia Pacific Journal of Tourism Research", has focus the blockchain technology is use in the smart city and tourism framework and present the blockchain technology evolve and influence in the industry [27].

Alexandre Dolgui et al (2020), "Blockchain-oriented dynamic modelling of smart contract design and execution in the supply chain, International Journal of Production Research", authors have developed and test the model for smart contract design in the supply chain with multiple logistics service providers [28].

Zhi Li et al (2019), CKshare: secured cloud-based knowledge-sharing blockchain for injection mold redesign, Enterprise Information Systems, Authors has proposed a blockchain based secured and distributed platform for knowledge sharing and private cloud technology [29].

Alexander Savelyev (2017), Contract law 2.0: 'Smart' contracts as the beginning of the end of classic contract law, Information & Communications Technology Law, authors has presented the applications of existing contract law provisions (smart contract), Blockchain smart contract implement in governments, transparency and digital citizenship [30].

Manal Mohamed Alhejazi et al (2021), "Enhancing the blockchain voting process in IoT using a novel blockchain Weighted Majority Consensus Algorithm (WMCA), Information Security Journal" Authors has proposed a novel decentralized blockchain Weighted Majority Consensus Algorithm that the detection of a malicious anomaly, as it is able to detect if a miner is honest, fake, or disable. Then based on this judgment the system may take strict actions to prevent the system from attacks [31].

Maral Sotoudehnia (2021), 'Making blockchain real': regulatory discourses of blockchains as a smart, civic service, Regional Studies," Author have focus the blockchain technology as a data -driving and producing civic service. Also focus on digital leadership, transparent data management and digital empowerment that blockchain to improve the government services [32].

Prateek Pandey et al (2020), "Securing and authenticating healthcare records through blockchain technology, Cryptologia", Authors has proposed a blockchain based secure architecture for e-healthcare systems [33].

QingQiu Gan et al (2021), "A critical review of blockchain applications to banking and finance: a qualitative thematic analysis approach", Author has presented the systematic Review on Blockchain applications in Banking and Financial sector with benefits, risks and challenges [34].

Jiaguo Liu et al (2021), "Blockchain technology in maritime supply chains: applications, architecture and challenges". Author has presented the detail review or Blockchain technology in maritime supply chains with

Impact, applications , architecture and challenges and proposed a blockchain-based maritime supply chain system (BMSCS) for global economic development [35].

V. CONCLUSIONS

This paper presents an overview of the emerging technique called Blockchain. Blockchain technology is becoming popular because of its decentralized, peer-to-peer transaction and immutable properties. This paper intends to address the key points such as Blockchain introduction, Blockchain types with its applications and each blockchain applications advantages and disadvantages with how to solve overcome disadvantages.

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