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Research Article

Modelling of Blockchain Technology

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ABSTRACT

Blockchain technology has been used in a variety of non-financial industries, including commerce, healthcare, and other fields. With the use of this technology, a decentralized environment free from the control of outside societies over data and transactions can be found. In essence, blockchain is a novel technology that has the potential to revolutionize future transaction-based transactions. Cross-border trade has traditionally been supported by financial tools. Blockchain technology has been implemented to develop trade finance processes. In the trade of tenants, anxiety reduction, payments, and financial solutions are essentially viewed as a cost optimization. This study looks at how the invention of Bitcoin has aided in the development of blockchain technology. The cryptocurrency is still in its infancy. Blockchain technology has been used to build an easy-to-use digital economy. The characteristics, benefits, and drawbacks of blockchain technology are examined thoroughly in this study article. It also examines how this technology is integrated with the development of trade finance and cryptocurrencies.

1. INTRODUCTION

The commercialization of blockchain possesses the ability to transform world trade finance and release trillions of dollars via a wide range of cost-saving measures. Every financial society, according to classical accounting, has a framed ledger of its own that verifies the balance of its clients' transactions [32]. In the context of blockchain, a computer network that houses a shared public registry with a record of all notable transactions is regarded as such. Blockchain is a particular kind of database that stores data in a manner distinct from that of representational databases. Blockchain maintains information in predefined, network-connected blocks. New data is added to a new block, which is then chained together with the blocks that came before it when it fills up [12]. In the case of cryptocurrencies, or more specifically, blockchain in Bitcoins, is employed in a decentralized manner, meaning that all users can keep control in a cooperative manner rather than any one person or group being able to govern.

The modern world is constantly in need of increased efficiency. This is true for practically every industry, including manufacturing, authority, and healthcare, as well as banking. The newest technologies must be included into educational programs in order to increase their general uniformity. The basis of a decentralized system can be established thanks to blockchain technology. in which no external entity controls the data. Every transaction that has ever been performed is continuously documented in a public ledger. This technology is predicted to revolutionize how businesses, industries, and educational institutions operate and to hasten the global spread of the knowledge-based economy. Blockchain technology is distributed in nature and controls the structures of decentralization, immutability, traceability, and service qualities through the use of cryptography techniques and agreement procedures [1]. These characteristics are likely to inspire a great deal of cutting-edge educational applications. Blockchain technology has the ability to compile and store an entire archive of all educational activities, including the steps involved and the outcomes, in both official and informal learning settings. Additionally, it logs teachers' instructional activities and provides an environment for evaluating instruction. Thus, blockchain offers a plethora of possible uses for educators and learners alike [2]. The educational stakeholders anticipated to use blockchain technology are depicted in Figure (1).

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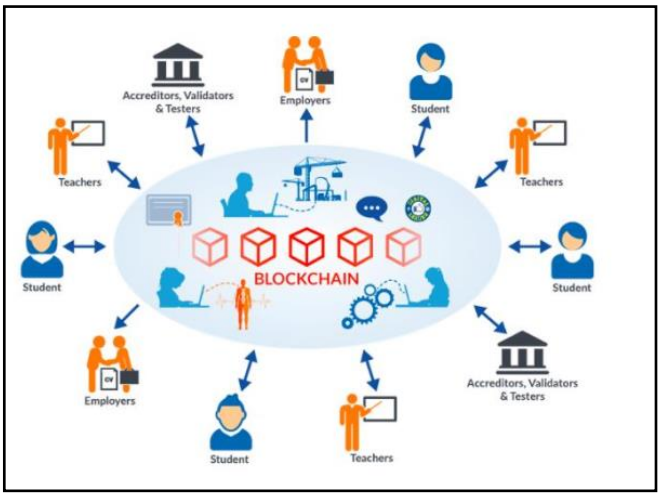

Fig. 1. Educational Stakeholders for use Blockchain.

People from the community, including clients, contractors, subcontractors, and dealers, are concerned about trust relationships in the structure manufacturing industry [22]. Previous studies have demonstrated that reciprocal trust facilitates smoother creativity processes, enables adaptability in the face of uncertainty, boosts output, and fosters enduring connections. In fact, appropriate contractual norms are always created to justify actions and intentions that conflict [23]. Nonetheless, the majority of current contractual relationships are founded on contentious situations that mirror the degree of confidence (or mistrust) in the agreement documents, which may be the primary factor driving up the total cost of an expressed goal [24]. International contracting is becoming more and more common these days, and structure projects are becoming more and more difficult [23]. These projects require the transfer of advanced structure technology as well as mutual project details circumstances with fair data argumentation; industry requirements are far removed from conservative constricting approaches and information exchange technologies.

Blockchain technology, which began with cryptocurrency in general Digital information can now be shared without being copied or altered thanks to Bitcoin. Data are stored in a crucial database that is accessible from multiple locations in conventional structure manufacturing. Given that a hacker could alter the transaction data, security is a critical issue. On the other hand, blockchain technology functions similarly to a shared database on a peer-to-peer network. After a predetermined amount of time, transactions are gathered into blocks and placed to a standing chain. After a block joins the chain, it cannot be removed, making the chain of transactions completely safe from hackers and publicly verifiable [25].

The foundation of blockchain technology is trust. Contributors who trust the blockchain itself do not need to have a formal relationship of trust in order for the building sector or activities to be conducted on it. Furthermore, by designating each project member as the guardian of all the data generated during the course of the project, blockchain technology handles the information exchange. In Blockchain, data is shared throughout the entire system, as opposed to Data transmission over the Internet, where information is exchanged between locations. As a result, nobody, not even the sender, knows more than everyone else. An intricate web of hundreds of procedures, people, goods, and resources makes up a building project. As a project advances, payments, transactions, and/or data exchanges are regularly made. During building, there are a lot of disagreements and legal actions. Even though a contract or agreement outlines another method, such as payment terms and data confidentiality, disagreements can emerge over the details of the established protocols [25].

2. BACKGROUND

This survey of the literature is divided into parts that discuss blockchain or Bitcoin-related works, works linked to modeling, and blockchain in education. Certain resources are interdisciplinary in nature; two examples are the modeling applications to blockchain networks and education networks.

A blockchain is a distributed database that contains all completed transactions or digital events shared by all parties involved. By agreement of the majority of system members, all transactions in the public ledger are validated by the participants. Information cannot be removed once submitted. Every transaction ever done is contained in a verifiable record on the blockchain, which makes these records worldwide.

The blockchain's characteristic properties, which are linked to network growth, visibility, trust-building, and the provision of safe data, can improve education systems and the digitization of education systems in a number of ways [19].

- Trust: Since the information on the blockchain is based on agreements made by multiple parties, it may be trusted. Over time, the participants establish a reputation on the blockchain that serves as a testament to their mutual trustworthiness. Furthermore, the blockchain network's inherent trust will eliminate the need for a intermediary between two parties. The goals of all parties involved must be evident in order for a blockchain network to build sufficient trust and connect [21].

The reputations of the participating organizations are now public and will continue to grow over time. It's critical for education systems that the chain's businesses can rely on one another to exchange information and streamline shared procedures.

- Greater transparency: Blockchain technology is making transaction records increasingly visible. As a result, updates to these histories can only be made through validation, which requires consensus from all parties. To modify one transaction, all subsequent records and the network's collective agreement must be adjusted. All participants with permissioned access can also access it [20].
- Network Expansion: The blockchain technology improves education systems by promoting network growth and interconnection. A public and open blockchain system would enable individual connections between users (employers, teachers, and learners) rather than relying solely on a centralized third party, decentralizing the network. As a result, technology utilized in educational systems worldwide will become more standardized, giving various educational systems the chance to collaborate in novel ways.
- Enhanced traceability: Every transaction made on the blockchain network is permanently recorded, making it possible to trace any data exchange or request back to its source with ease.
- Enhanced speed and efficiency: All operations that rely heavily on paper are labor-intensive and prone to human mistake. Processes can be finished more quickly and effectively by using blockchain to automate and streamline them. It is simpler for players to trust one another without the need for several middlemen when they have access to the same information [44, 45, 46].
- Lower costs: For the majority of businesses, cutting costs is a top objective. Blockchain eliminates the need for intermediaries in transactions. Rather, the data on the blockchain needs to be trusted by all participants.

Additionally, since every member will have authorized access to a single, unchangeable network, participants must study all of the accompanying documentation in order to finish a request.

3. BLOCKCHAIN TYPES

Three primary types of Blockchain emerged following Bitcoin's introduction of this technology to the global market. Among them are:

1. Public Blockchain:
   This kind of network, usually referred to as a decentralized network, allows information to be publicly accessible and is not owned by a single party. Because the network is decentralized, everyone can access the data because it is completely public. The public blockchain is home to numerous cryptocurrency currencies, including Litecoin and Bitcoin [13]. Anyone has the freedom to follow Litecoin networks whether using Bitcoin or any other cryptocurrency. Items that genuinely explain how to declare something as public on the blockchain. Anyone is accepted to run there. Utilizing the LTC/BTC full node, begin the mining procedure. able to carry out transactions on the LTC/BTC blockchain and to audit or examine the blockchain using a blockchain explorer.
2. Private Blockchain:
   On a private blockchain, access to the network is authorized and entirely regulated. The private blockchain, in contrast to the public blockchain, is managed by an individual who is responsible for important aspects such as authorisation and read/write access. The agreement rests solely on the whims of the person in charge, who might grant anyone or no one the permission to mine [8]. That includes the bank chain process. No one can initiate a full node and start mining on such a blockchain; no one can conduct a transaction on the chain; and no one can audit or study the blockchain using a blockchain explorer.
3. Federated or Consortium Blockchain:
   This is known as a semiprivate network, which can take ownership and is managed by a particular entity. In this instance, individual autonomy is taken away by the blockchain and given to a single entity. For instance, the federated or consortium blockchains r3 and EWF allow participants to run a full node and initiate the step-by-step activity. A blockchain explorer can be used to study or assess the blockchain, and mining can be used to make decisions or conduct business on the blockchain [9].

4. BLOCKCHAIN TECHNOLOGY

The permissioned-distributed ledger system known as blockchain, which powers the Bitcoin cryptocurrency [26], guarantees the integrity of transaction data [27]. It is possible to keep the distributed ledger [28] secret or make it public. Anybody can access and maintain a public ledger, as it lacks a central owner. The ledger is distributed in exact duplicates to every user on the network. A private ledger is one in which only a select group of players who have been pre-approved are permitted to participate and transact while being watched over from the outside. Since the blockchain information exchange is decentralized, all participants in the ecosystem have equal access to the same data. Maintainability of data and information without the involvement of any organizations or governmental agencies is one of the core characteristics of blockchain.

Three classes of blockchain technology were distinguished by [29]: Blockchain 1.0, 2.0, and 3.0. Below is a detailed explanation of each of them.

The goal of Blockchain 1.0 is to decentralize money and payments. Bitcoin is one instance of this type of application. Blockchain 1.0's main characteristic is that any transaction can be started and finished directly over the Internet between two people. Unlike fiat currencies, which allow governments to print additional money, the money supply of Bitcoin grows at a set rate. 13.5 million of the new currency are now in use as of right now and a maximum of 21 million in 2040, it is being issued at a steady and predictable rate. Blockchain 2.0 aims to decentralize markets overall and envisions transferring a range of assets besides money via the blockchain, which creates a unit of value each time it is divided or transferred. Blockchain 2.0 includes features such as Decentralized Applications (Dapps), Decentralized Autonomous Organizations (DAOs), Decentralized Autonomous Corporations (DACs), Bitcoin 2.0 and related protocols, smart contracts, and smart property. It may be possible to recreate all financial transactions on the blockchain, encompassing those pertaining to bonds, mutual funds, equities, annuities, private equity, derivatives, and pensions, and crowdfunding tools. Digital identities, public documents (such titles to real estate, business permits, and vehicle registrations), and private documents Both public and private data, including identity cards, passports, and driver's licenses, can be transferred and maintained on the blockchain. Examples of the former include loans, signatures, and escrows. Blockchain attestation can be used for notarized paperwork, ownership verification, and insurance evidence. The blockchain may be used to encode, secure, track, and transfer both tangible goods like cars and homes and intangible assets like patents and copyrights.

Blockchain 3.0 is intended for use in justice-related applications, particularly in the fields of politics, health, science, education, and the arts. It goes beyond money, economics, and markets. The freedom aspect of the blockchain is made more apparent in Blockchain 3.0, which is basically a new paradigm for efficiently and smoothly arranging operations. A human-computer interaction as well as the coordination and acknowledgment of all human connections can be significantly enhanced by blockchain 3.0. One of the main uses of blockchain is to provide decentralized government services by acting as a global, permanent, continuous, consensus-driven, publicly auditable, redundant record-keeping repository. 3.0: government using blockchain technology.

5. KEY FEATURES OF BLOCKCHAIN TECHNOLOGY

1. Enhanced Protection
   If a node is changed, only the data in that node will change—the data throughout the network remains unchanged—because a central authority is not necessary. Every transaction involves a test of the nodes' legitimacy.
2. Decentralized Technology
   The fact that the network is distributed indicates that it lacks a central authority or a single person in charge of it. Instead, the network is supported by a number of nodes, making it decentralized.

6. ADVANTAGES OF BLOCKCHAIN TECHNOLOGY

The blockchain technology has a number of advantages that are listed here, including:

1. Logistics
   In many circumstances, the logistics sector has demonstrated that the use of blockchain technology is very advantageous since it lowers expenses and boosts productivity. Smart contracts and digital bills of lading, according to [30], can help reduce expenses by 20% to 30% [17].
2. Diamond Industry
   Thanks to technology, diamond sellers can now use a blockchain ledger in place of the conventional certification procedure. A London-based business called Ever Ledger has put over 2 million jewels on the blockchain to prove the origins of the diamond's products in an effort to halt the trafficking of "blood diamonds".
3. Healthcare and Insurance
   The introduction of blockchain technology into the healthcare and insurance departments has streamlined the process of keeping track of patient information while simultaneously cutting costs [11]. The technology also aided in maintaining track of the patients' records inside the hospital in a timely manner. The data is subsequently stored on the blockchain, enabling rapid, safe access by authorized users to the records, improving medical diagnosis and accuracy. Subsequently, the insurance sector adopts the same methodology.
4. Food Chain Safety
   Blockchain technology has facilitated knowledge acquisition in a time when people are worried about the provenance of the food, they eat every day [10]. Customers can obtain information on a product, such as its manufacturing location, ingredients, date of birth, and other specifics, by swiftly scanning the QR code found on food packaging with a smartphone. This information is provided to customers in an easy-to-use manner.

5. Paperless society

The authenticity of the documents, as well as their security, were not assured when paperless trade was originally implemented by electronic methods. The only way to ensure that the documents were safe from alteration was to use a decentralized network that only the corresponding respondents could access.

6. Fight Against Corruption
   Every nation faces corruption, which is seen as a serious problem. The only way to effectively regulate the misappropriation of public funds is to use blockchain technology [36]. Only if state monies are used efficiently will the public be able to oversee them appropriately.

7. DISADVANTAGES OF BLOCKCHAIN TECHNOLOGY

1. Cryptojacking
   The security issue, termed as "cryptojacking" is of high importance nowadays. This engages the person's CPU via cryptocurrency without prior permission. Hackers and many website owners exploit this cryptocurrency method for their financial gain, which includes hacking anyone's CPU.
2. technological complexity
   Even though consumers are not blockchain experts, the goal of encouraging the widespread use of blockchain technologies is entirely dependent on technology, which is unquestionably necessary for user-friendly interfaces [15].
3. Scalability is a huge issue
   The reason Blockchains are not seen as scalable is because their equivalent is a centralized system. The likelihood of getting slower tends to start when the number of nodes or users on the network starts to increase. Even Nevertheless, the Bitcoin network currently has scalability possibilities thanks to appropriate advancements in contemporary technologies.

8. COMPARISON BETWEEN PUBLIC AND PRIVATE BLOCKCHAIN

The degree of platform accessibility distinguishes between the public and private blockchain. Everybody using the Blockchain has the ability to transact in public. Conversely, such authorization is given in private to a chosen participant. A comparative analysis of public and private blockchains types is displayed in Table I.

TABLE (I): COMPARATIVE ANALYSIS OF PUBLIC AND PRIVATE BLOCKCHAINS.

PROPERTY	PUBLIC BLOCKCHAIN	PRIVATE BLOCKCHAIN
CONSENSUS DETERMINATION	All Parties	One party
READ PERMISSION	Public	Public or Private
IMMUTABILITY	Nearly impossible to corrupt	Could be corrupted
EFFFICIENCY	Low	High
CENTRALIZED	No	Yes
CONSENSUS PROCESS	Permission-less	Permissioned

9. BITCOIN AND BLOCKCHAIN

The blockchain, a distributed ledger system, is linked to the virtual currency bitcoin. The first mention of it was made on a cryptography mailing group in late 2008 when an author going by the pseudonym Satoshi Nakamoto [26] posted a white paper titled "Bitcoin – A Peer-to-Peer Electronic Cash System." These users can now transact directly, without the need for an intermediary, over an open, insecure network like the Internet due to the Bitcoin system. In 2009, this peer-to-peer technology was released as open-source software [4]. Since then, it has developed into a 24/7 system that can now handle several hundred thousand transactions every day. Bitcoin expands on previous attempts to establish virtual money as well as cryptography research ([7], [9], and [10]). The three primary features of Bitcoin are: (1) its peer-to-peer architecture; (2) its unique use of blockchain technology for storage, which includes transaction validation and time stamping; and (3) its consensus procedures that define its security model and set of rules [3]. The blockchain functions as a distributed database, continuously expanding to include more and more organized records, or blocks, along with transactions. Several kinds of data can be obtained by a transaction. Every block has a timestamp and a cryptographic reference to the block before it. Through transactions, each individual bitcoin in Bitcoin is also connected to the others (ibid.). High volume transactions are

not recommended for the Bitcoin network because it can only process a theoretical maximum of seven transactions per second [5]. Nonetheless, it is perfect for the effective storage of more durable items and assets (such licenses, certificates, etc.). These kinds of items don't change hands frequently enough to cause problems for Bitcoin's comparatively modest transaction speed. Because of its open, distributed, and global architecture, interoperability as well as cost-effective and safe asset storage are promised, along with a relatively cheap cost of transactions and a high level of security. Additionally, assets like licenses, diplomas, and certificates can be combined with this. An easily accessible platform can help the public sector save money on investments. By combining a consensus-based system among its peers with a proof-of-work (PoW) approach influenced by Hash Cash [34] and Reusable Proof of Work (RPOW) [35], Bitcoin was able to overcome the previous issue of preventing double-spending (the expenditure of a single digital token twice). The PoW-based security paradigm is predicated on the assumption that breaking into the system will cost more money than it will bring in. The main purpose of Proof of Work (PoW) in Bitcoin is to determine a hash value by combining the hash value of the previous block, a "nonce," and the hash of the current block [6]. Hash functions are essential for digital signature validation and verification, as well as for document authentication [33]. Even though the blockchain technology is the main topic of this paper, it's crucial to comprehend how closely related the bitcoin currency and the underlying blockchain technology are. Without incentives or recompense systems like Bitcoin, an open, permissionless blockchain is impossible (ibid.). The bitcoin currency is a vital incentive to protect the transfer of ownership of data and assets, even if the blockchain can hold information except the transactions involving the currency. The incentive for miners to invest resources (mostly electricity and hardware) in determining the precise hash value and protecting the transactions is the potential for earning additional bitcoins (ibid.). By far the most secure blockchain system in use today is Bitcoin due to the enormous amounts of resources required to compute hash values [14]. There's a widespread misperception that blockchain technology is inherently secure [3]. It is actually necessary to specify the security technique; the contrary is true. An open blockchain and a closed (private) blockchain are fundamentally different [3]. Since open blockchains, such as Bitcoin and Ethereum, are permissionless networks where anybody may participate and even create new solutions, they require a security architecture to protect transaction data and incorporate a consensus mechanism. The PoW model is currently the only one running at scale. Conversely, closed blockchains need to rely on conventional security measures to stop unauthorized users from accessing and altering the blockchain. Technically speaking, hash functions and public key cryptography which are used to create digital signatures and validate transactions are the two main cryptographic components that underpin Bitcoin [1]. A Bitcoin transaction is a digital signature that verifies a transaction that includes the address of the payer, the address of the recipient, and the total number of bitcoins sent. The transaction is spread throughout the Bitcoin network, such as the nodes that house every user of the core program, and eventually it is combined with other transactions to form a block (ibid). The proof of work (PoW) component of the mining process, which involves using computer power to solve a mathematical challenge, links the new block to the blockchain. Newly created bitcoins are awarded to the first miner to solve the riddle correctly. The Bitcoin system's contribution from miners and the full node clients' control mechanisms makes it possible to do away with the need for third parties to approve transactions. Bitcoin was the first virtual currency system to be implemented. There are now hundreds of different virtual currencies known as altcoins as a result of multiple copies being generated over the years. These cryptocurrencies can also serve as real-world and real-time testbeds for new features, as well as other platforms for digital currency solutions. These include Monero, Dash, Zcash, Ethereum, which focuses on smart contracts [16], and all of them offer greater anonymity than Bitcoin. The governance of blockchain development is a crucial component. No group of stakeholders, such as miners, full node clients, or core developers, is in control of Bitcoin; instead, agreements between the various parties must be made. Bitcoin Improvement Proposals, or BIPs, are suggestions for protocol changes that are put to a vote by miners. By downloading updated versions of the reference client or opting not to download, full node clients can cast their "votes" [18]. But recently, there has been discussion about whether to increase block size in order to improve throughput and relieve the burden of accumulating unconfirmed transactions. This has led many to refer to this issue as a governance crisis [18]. There is no conflict resolution mechanism in Bitcoin. This ultimately results in crippling impasses, which appear to be the case at the moment (ibid.). If blockchain technology is being used as a platform for open digital services, then governance becomes important. The basic architectural ideas of Bitcoin are shared by almost all altcoins. They differ from Bitcoin in a number of aspects, including capacity, hashing techniques, and monetary policies. Alternative coins are not compatible with Bitcoin, and if a cryptocurrency undergoes a hard fork a change in its protocol that is not backward compatible there is a chance that a new altcoin will emerge if users do not accept the change in unison. Following a contentious hard fork in 2016, the Ethereum platform divided into Ethereum and Ethereum Classic [31].

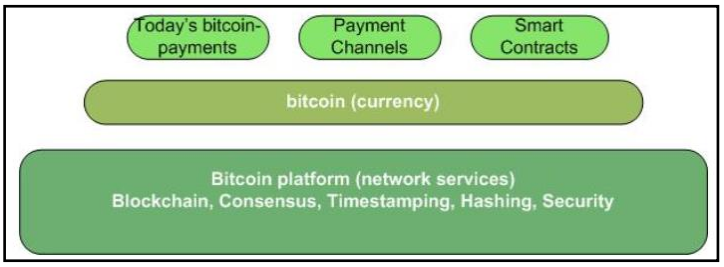

Fig. 2. Bitcoin's layered architecture

10. CONCLUSIONS

Blockchain technology holds promise for revitalizing sectors outside banking. This article examines the ways in which bitcoin technology has been used to support international finance. The digital currency has been scrutinized. Because of its many benefits, it has been discovered that innovation in bitcoin operations has completely changed how global finance is carried out. Because of its adaptability, cryptocurrency may be used in a number of industries, including the food and health sectors. The rapidity of bitcoin transactions is a unique trait that contributes to their widespread acceptability and boosts international trade. Lastly, a succinct explanation of cryptocurrencies, their varieties, and how they relate to blockchain technology is provided.

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Conflicts of Interest:

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