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Blockchain, Evolution, and Future Scope: An Overview

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Abstract

A blockchain serves as a transparent and immutable record of transactions, offering unparalleled security and trust in a digital environment. Its decentralized nature ensures that no single authority has control over the network, fostering a level playing field for all participants. While cryptocurrencies such as Bitcoin have popularized blockchain technology, its potential extends far beyond digital currencies. In addition to financial transactions, blockchain can revolutionize various industries, including supply chain management, healthcare, real estate, and voting systems. Its tamper-proof nature and ability to track assets in real-time make it invaluable for ensuring the authenticity and integrity of products throughout the supply chain. Moreover, blockchain-based solutions in healthcare can securely store and share patient data, enhancing interoperability and privacy. Furthermore, the concept of decentralized autonomous organizations represents a paradigm shift in governance and decision-making. By leveraging smart contracts on the blockchain, decentralized autonomous organizations enable autonomous, transparent, and efficient collaboration among individuals or entities without the need for intermediaries. This innovation not only streamlines processes but also mitigates risks associated with centralized authority and human error. As blockchain technology continues to evolve, its impact on society and the economy will become even more profound. From enabling peer-to-peer transactions to revolutionizing governance structures, the potential applications of blockchain are virtually limitless. Embracing this technology opens up new possibilities for innovation and collaboration, ushering in a new era of trust and transparency in the digital age.

Keywords: Blockchain, bitcoin, cryptographic currency, Ethereum BCT, transaction, Healthcare systems

INTRODUCTION

Blockchain can be defined as a data system that stores records of transactions while supporting decentralized management, security and transparency. It can also be viewed as the history of the chain, stored in blocks and controlled by various authorities. Blockchain is a distributed ledger that anyone on the internet can use. However, once information is placed on the blockchain, it is very difficult to change or modify it. Every transaction on the blockchain is protected by a digital signature that verifies its legitimacy. Due to the implementation of encryption and digital signature, the data stored in the blockchain is tamper-proof and unalterable [1].

This machine ensures consensus, the process of reaching agreement among all network users. In blockchain, all information is stored digitally and has a common history that is visible to everyone in the network [2].

By doing this, you avoid using third parties and prevent fraud. BCT achieves consensus, the process by which all network users agree. Every piece of

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information stored on the blockchain is digitally recorded and has a good history for everyone on the network [2, 3]. By doing this, you avoid using third parties and prevent fraud or scams.

In simple words, a block is a group of transactions that have been rationally prepared by being grouped together. Its size varies as per the type and layout of the blockchain being employed and is made up of transactions. Unless it's a genesis block, the block additionally contains a reference to a preceding block [3]. The initial block in a blockchain that was hardcoded when the blockchain was created is known as a genesis block. Depending on the kind and architecture of a blockchain, the structure of a block may vary, but generally speaking, a few properties, including the block header, references to preceding blocks, the transaction counter, transactions, time stamp, nonce, and other properties, are present, are crucial to a block's functionality [2]. Figure 1 illustrates the working of blockchain.

EVOLUTION OF CRYPTOCURRENCY

Bitcoin

Bitcoin, the first decentralized cryptocurrency, does away with middlemen thanks to its network of peers. The blockchain is a widely used public ledger where transactions for Bitcoin are recorded. In contrast to the existing limit of 21 million Bitcoin tokens in circulation, there are currently more than 18 [2].

Litecoin

Charlie Lee, a former Google employee, invented Litecoin in 2011. He developed changes to the Bitcoin protocol that resulted in faster transaction times, lower transaction fees, and a concentration of miners [4].

Ethereum

In July 2015, Vitalik Buterin unveiled Ethereum. Ethereum is currently the second-biggest cryptocurrency by market valuation, just after Bitcoins. Both Solidity, the programming language used by the blockchain network Ethereum, and Ether (ETH), the digital currency it uses, are proprietary [3].

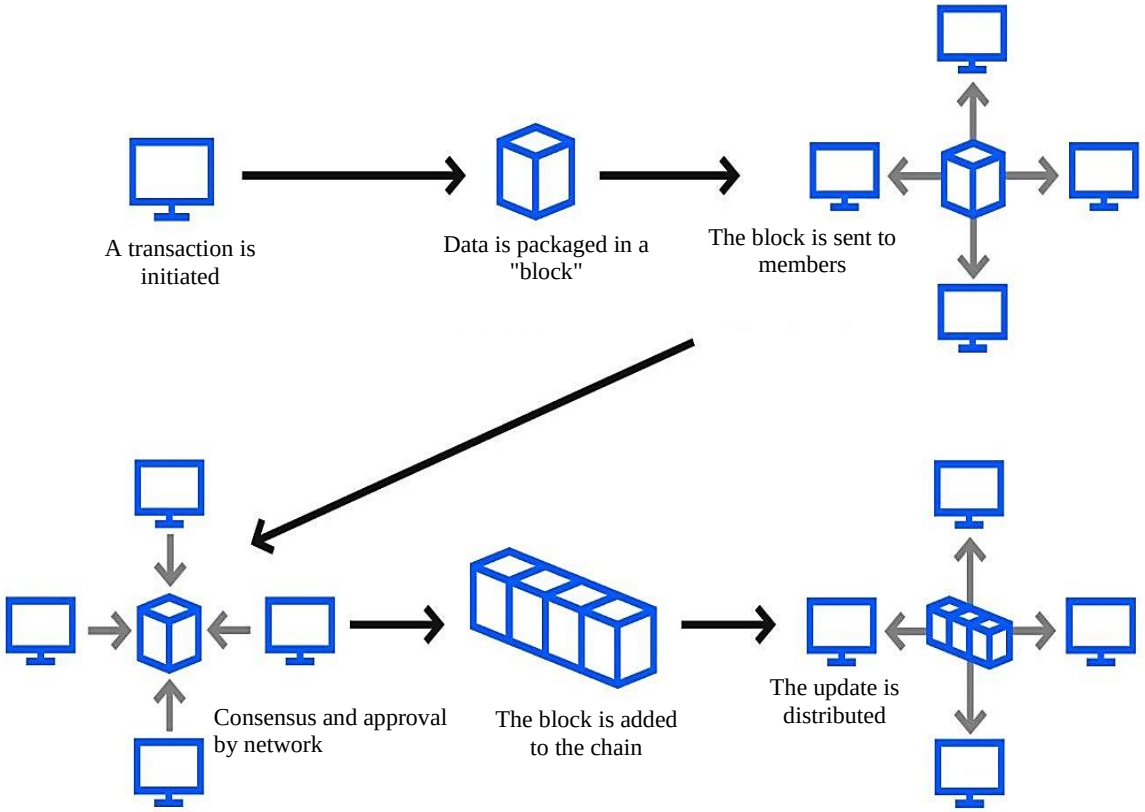

Figure 1. Diagram of blockchain.

Ripple

Ripple is a type of cryptocurrency, much like Litecoin or Bitcoin, that operates on an open-source, decentralized infrastructure that makes it simple to transfer money in any format. The currency used by Ripple, XRP is the name of a blockchain based protocol and digital payment network.

NEO

The Chinese-developed cryptocurrency NEO, originally known as Antshares, is actively trying to come over other significant competitors in the global cryptocurrency market. It is the hub around smart contracts (also known as digital contracts), allowing users to create and execute contracts without the need for an intermediary.

IOTA

IOTA is an IoT application that was created in 2016. There will be billions of devices online by 2020. When conducting daily transactions in an Internet of Things context, elegant devices can exchange data along with payment information with a wide range of other devices. IOTA intends to become the standard for conducting transactions on smart devices in place of other ways.

STAGES OF ADVANCEMENT OF BLOCKCHAIN

An explanation of each stage in the development of blockchain is provided below:

Stage 1

Blockchain 1.0 (Bitcoin Emergence): 2008–2013 This is the first type of blockchain that supported distributed ledgers, Merkle trees, digital currency, proof of work, and blockchain data. It was first presented in 2008 by Satoshi Nakamoto [2, 5, 6]. The first release is version 1.0. It is the most fundamental type and operates on a 16-bit architecture [2, 3, 6].

Stage 2 (Contracts)

2013–2015: Blockchain 2.0 (Ethereum Development)

Phases of block chain is depicted in Figure 2.

- Vitalik Buterin began building what he believed to be an elastic blockchain that can do an array of functions in addition to operating as a point-to-point network because Bitcoin had some limitations [3].
- The 2013 announcement of Ethereum, a brand-new public blockchain with more functionality as compared with bitcoin [7].
- Vitalik Buterin distinguished Ethereum from the Bitcoin Blockchain by enabling users to book additional assets kind of contracts and trademarks in accumulation to bitcoin transactions.
- The most recent update added a foundation for creating decentralized apps, expanding Ethereum's capabilities beyond that of a currency [7].
- The Ethereum blockchain, which can handle smart contracts used to perform a range of activities [3].
- Ethereum BCT has proven effective in uniting a robust developer community, enabling it to create a real ecosystem.

The most daily transactions occur on the Ethereum BCT, which can manage decentralized apps and smart contracts. The market capitalization of the bitcoin sector has also dramatically increased [3].

2015: Hyperledger

- They are known as Hyperledger, and up until now, it has been a combined effort for the creation of dispersed ledgers [8].
- Hyperledger, led by Brain Behlendorf, aims to advance industry-wide teamwork for the advancement of BCT and distributed ledgers.
- The goal of Hyperledger is to improve the dependability and performance of modern systems to facilitate international business operations [8].

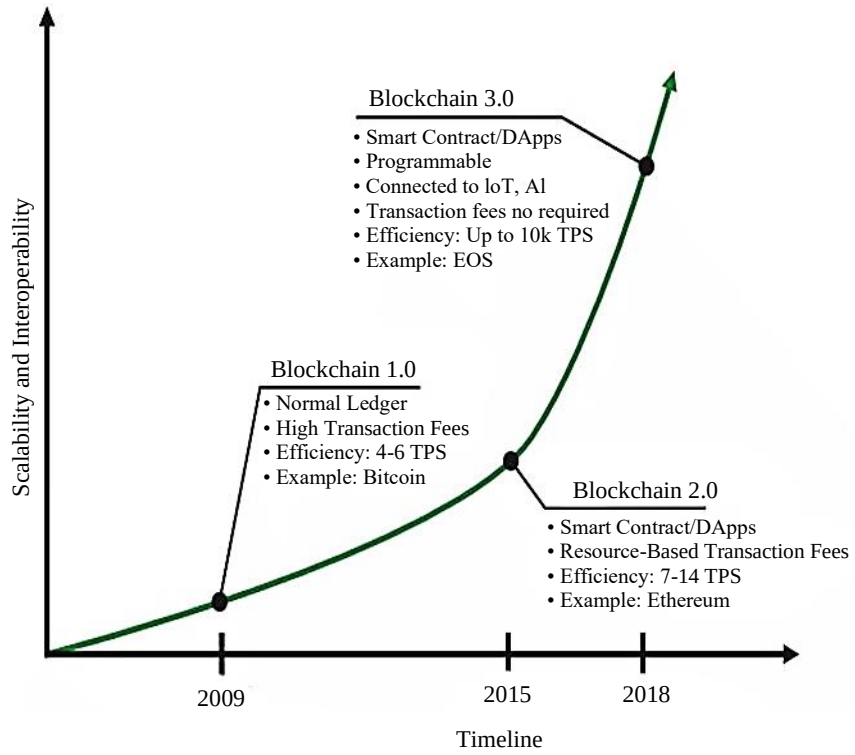

Figure 2. Phase of Blockchain.

Stage 3 (Applications)

2016–2018: Blockchain 3.0 (DApps)

Applications supported by blockchain can be scaled up, provide a good user acquaintance, and are better operable [9].

- Numerous initiatives have surfaced in current years that take advantage of the possible of BCT. Numerous initiatives have surfaced in modern years that build advantage of the prospective of this technology.
- Various projects have aimed to fix a number of the issues with Bitcoin and Ethereum in accumulation to creating novel features that use BCT.
- One of the most recent blockchain uses is NEO, which bills itself as the 1st open-source, decentralized, and blockchain platform to be published in China [10].
- NEO brands itself as the Chinese Ethereum and has the objective to challenge Baidu's hegemony in the nation; it has already received sponsorship from Alibaba CEO Jack Ma [10].
- The cryptocurrency platform promises to offer fee-free transactions and distinctive verification procedures; therefore, it was created for the Internet of Things [9, 10].
- IOTA was urbanized as a result of certain developers' decision to employ BCT to speed the growth of the IoT.
- The second-generation blockchain platform is also creating a stir in the market [10].
- Collaborations like Microsoft appear to be moving in the right direction when considering the new blockchain applications that are being developed in some private, combined, and federated blockchains [9].

2017: EOS.IO

- In 2017, a private corporate block published a paper proposing a novel blockchain system that used EOS as the inhabitant token [11].
- Only two examples of traits that EOS tries to imitate are the GPU and CPU. Smart contracts can be used on the decentralized operating system IO.

- Through a self-reliant decentralized organization, the main goal is to encourage the adoption of decentralized apps (dApps).
- The main aim is to support the development of decentralized apps through a stand-alone decentralized company.
- DApps (decentralized applications) run their decentralized peer-to-peer networks' backend code [11–14].
- Just like a typical app, any language that can call its backend may be used to write the user interfaces and frontend blockchain example code for a dApp [15–19].

2020: The Future: Blockchain 4.0 (Industry)

Blockchain 4.0 outlines methods and answers that enable BCT to be used for commercial and industrial purposes.

- BCT's future looks to be brighter as multiple companies, governments, and various organizations are making notable big investments in it to promote new innovations and applications.
- Supply management and the cloud computing industries both exist already heavily utilizing the technology [20, 21].
- Future uses of the technology should incorporate commonplace devices like web search engines.
- According to Gartner Trend Insights, by 2022, at least one BCT based company will allegedly have a market value of over $10 billion [22].
- According to the research firm, the blockchain digital revolution would cause business value to transcend $3.1 trillion by 2030 and extent over $176 billion by 2025 [22]. Figure 3 illustrates four stages of blockchain.

BLOCKCHAIN APPLICATIONS

- *Cryptocurrency:* The most widely used use of BCT is cryptocurrency, which uses it to make money transfers secure and decentralized [2, 21, 5].
- *Voting system:* It can be used to design a safe and open voting process to prevent or limit tampering and fraud [23].
- *Gaming:* Self-executing contracts, which are transparent, safe, and impenetrable, can be made using BCT [24].
- *Supply chain management:* It can be employed to keep track of how items travel across the supply chain and to make a clear record of every action taken [20, 21, 25].
- *Healthcare:* By improving data security, interoperability, and transparency, BCT has the potential to completely transform the healthcare sector [26]. Here are some notable applications of blockchain in healthcare:
    1. *Data security and privacy:* Since blockchain offers an immutable, decentralized ledger, it is suited for protecting sensitive patient data. The blockchain can be used to hold medical records, data from clinical trials, and individual patient health information, protecting privacy and limiting unauthorized access [24, 26].

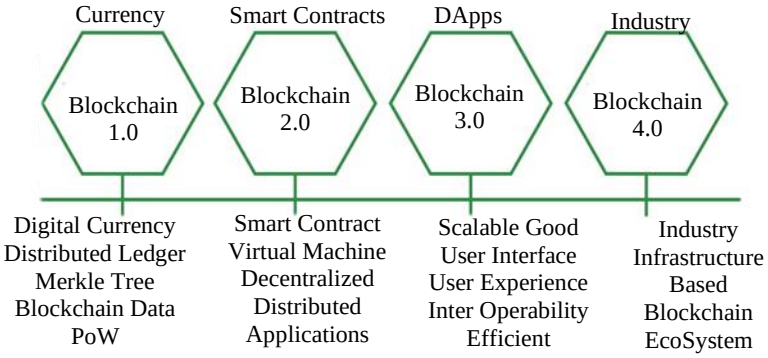

Figure 3. Stages of blockchain.

2. *Interoperability:* Healthcare systems frequently experience interoperability problems, which make it difficult for patients' data to be shared easily between various providers and organizations [26]. BCT can make it possible for diverse healthcare systems to communicate data in a standardized and secure manner, improving care coordination and continuity [24, 13].
3. *Clinical studies and medical research:* By securely storing and managing trial data, patient consent, and trial results, blockchain helps streamline the management of clinical studies. Processes may be automated with the use of smart contracts, assuring compliance and transparency while easing administrative constraints [13].
4. *Drug traceability and supply chain management:* Blockchain can improve pharmaceutical product traceability by keeping track of all supply chain steps, from manufacturing to distribution [26]. By doing so, the supply chain's integrity is protected, and counterfeit pharmaceuticals are less likely to be distributed [25].
5. *Health insurance and claims processing:* By safely storing contract information, claims data, and information about policyholders, blockchain can simplify and streamline the processes involved in handling health insurance [26, 27]. Claims processing can be automated using smart contracts, which lowers processing times, administrative expenses, and fraud.

- *Smart contracts:* Using BCT, self-executing, transparent, and secure contracts may be made [7].
- *Identity verification:* By building a decentralized and secure system and removing the need for centralized authorities to manage identification information, blockchain can be utilized for identity verification [20, 21].

RESULTS

Enhanced Security

BCT has the ability to significantly affect the way that others see your sensitive and important data. Blockchain creates an immutable, end-to-end encrypted record that stops fraud and criminal behavior. By implementing access restrictions and data anonymization on the blockchain, privacy issues might be handled [28, 29].

Greater Transparency

Each company would need to run its own database without blockchain. Blockchain uses a distributed ledger to ensure that information and transactions are recorded consistently worldwide [12].

This allows members to view the complete transaction history, virtually eliminating the potential of fraud.

Instant Traceability

Blockchain establishes an audit trail that records the origin of an object at each stage of its travel. In markets where customers are concerned about a product's impact on the environment or human rights, or in markets where there is a high incidence of fraud and counterfeiting, this helps provide the proof [30, 31].

Enhanced Efficiency and Speed

Traditional paper-based processes require third parties to mediate and are time-consuming, prone to human error, and inefficient. Blockchain-based automation of these procedures may enable more rapid and effective transaction completion [32, 28, 26, 30, 33, 34].

Automation

With "smart contracts," transactions may also be automated, boosting your productivity and accelerating the process even further. The following step of a transaction or process is automatically initiated when pre-specified requirements are satisfied [32, 7].

CHALLENGES IN MASS ADOPTION

The following list of BCT difficulties includes real-world examples:

- *Scalability:* As transaction volumes rise, scaling issues with blockchain arise. For instance, the block size and processing capacity of the Bitcoin blockchain are constrained, which causes longer transaction times and higher fees during times of heavy demand [21].
- *Energy consumption:* Some blockchain networks need a lot of processing power and energy, especially those that use Proof of Work consensus processes. Concerns concerning sustainability have been raised in light of how energy-intensive blockchains like Bitcoin affect the environment [21, 14–19].
- *Interoperability:* It can be difficult to get multiple blockchain networks to function together. For instance, maintaining data consistency and interoperability between systems or transferring assets between different blockchains can be challenging and impede seamless integration.
- *User experience:* It can be difficult for BCT to gain widespread adoption because users frequently need to manage private keys, wallets, and sophisticated procedures. For greater adoption, it is essential to enhance the user experience and provide user-friendly interfaces.
- *Regulatory and legal uncertainty:* BCT frequently works in a legal and regulatory gray area. Laws differ from one jurisdiction to another, and legal systems find it difficult to keep up with the rapid innovation in the blockchain industry. Businesses and users have difficulties in terms of compliance and legal clarity as a result of this uncertainty [9, 12].
- *Security and privacy:* Although blockchain promotes transparency, protecting user privacy might be difficult. It is critical to strike a balance between openness and privacy.
- *Consensus and governance:* Managing consensus mechanisms and decision-making procedures inside blockchain networks can be difficult. It can be difficult to obtain agreement among participants with divergent interests and to ensure that governance models are functional and meet the various needs of stakeholders [9].
- *Blockchain education and skill gap:* Due to the technology's rapid development, there is a dearth of people with knowledge of blockchain implementation, security, and development. To fully utilize blockchain, the knowledge gap must be closed and a competent workforce must be developed.
- *Legal identity and KYC/AML compliance:* For adherence to legal requirements like Know Your Customer (KYC) and Anti-Money Laundering (AML) laws, blockchain applications frequently require participant identity verification. It is difficult to provide secure, decentralized identity verification solutions while upholding regulatory requirements [9].
- *Resistance to change and adoption:* Traditional industries, well-established institutions, and regulatory authorities frequently oppose the introduction of BCT. It takes educating stakeholders about the advantages, resolving common misconceptions, and showcasing successful use cases to overcome skepticism and promote acceptance [35–37].

These difficulties bring to light some of the challenges that need to be resolved on a practical level for BCT to fulfill its full potential. They will need to be overcome through continued research, innovation, stakeholder cooperation, and regulatory clarity.

INTERSECTION WITH OTHER TECHNOLOGIES

The future of BCT will be greatly influenced by its intersections with other technologies. The following are some crucial areas where blockchain and other cutting-edge technology interact:

- *Artificial intelligence (AI):* When blockchain and AI are combined, it could lead to the development of useful applications. Blockchain can offer a private and transparent platform for sharing data with AI models while maintaining the integrity of the data. By analyzing massive volumes of data, automating procedures, and boosting decision-making algorithms, AI can improve blockchain systems [20, 38].
- *Internet of Things (IoT):* Blockchain can offer a safe and decentralized framework for Internet of Things (IoT) gadgets. IoT devices may securely exchange data, carry out transactions, and build

trust without relying on a centralized authority by utilizing BCT. New IoT applications like supply chain management, smart cities, and autonomous vehicle networks may be made possible by this integration [38–40].

- *Cloud computing:* Blockchain and cloud computing can work together to enhance each other. Cloud-based systems' security, privacy, and auditability can all be improved by this technology. However, to reduce the danger of data breaches and unauthorized access, it can provide decentralized and tamper-proof records of data transfers and transactions. In contrast, cloud computing can deliver the processing strength and storage needed for blockchain networks to scale and function effectively [20, 3].
- *Big data analytics:* Blockchain can make it possible for numerous parties to share information in a secure and auditable manner, enhancing big data analytics. In data-sharing networks, BCT can guarantee data integrity, privacy, and consent management. Additionally, it can make it easier to build decentralized marketplaces for data exchange where users can keep control and ownership of their data while still gaining from its value.
- *Cybersecurity:* BCT has the ability to completely change cybersecurity procedures. Blockchain's decentralized and unchangeable structure can improve data security, identity verification, and authentication processes. Blockchain-based cybersecurity solutions can provide more robust and secure digital infrastructure by preventing data breaches, fraud, and tampering [41, 42].
- *Edge computing:* Blockchain can give edge computing networks a distributed and secure foundation, enabling reliable transactions, data exchange, and device coordination. Peer-to-peer interactions in edge computing environments can be made efficient and safe thanks to this combination.
- *Machine learning (ML):* The combination of blockchain with ML can create new opportunities across a range of industries. Insuring data provenance, privacy, and auditability, BCT can offer ML models secure and transparent data architecture. A further way that ML algorithms can be employed to improve the effectiveness and intelligence of blockchain systems is by analyzing blockchain data, spotting trends, and making predictions [43, 44].

In addition, deep learning-based applications can be enhanced by considering the main features of deep learning and blockchain as summarized in Table 1. Furthermore, various merits resulted from the integration of BCT and deep learning are depicted in Figure 4 [45].

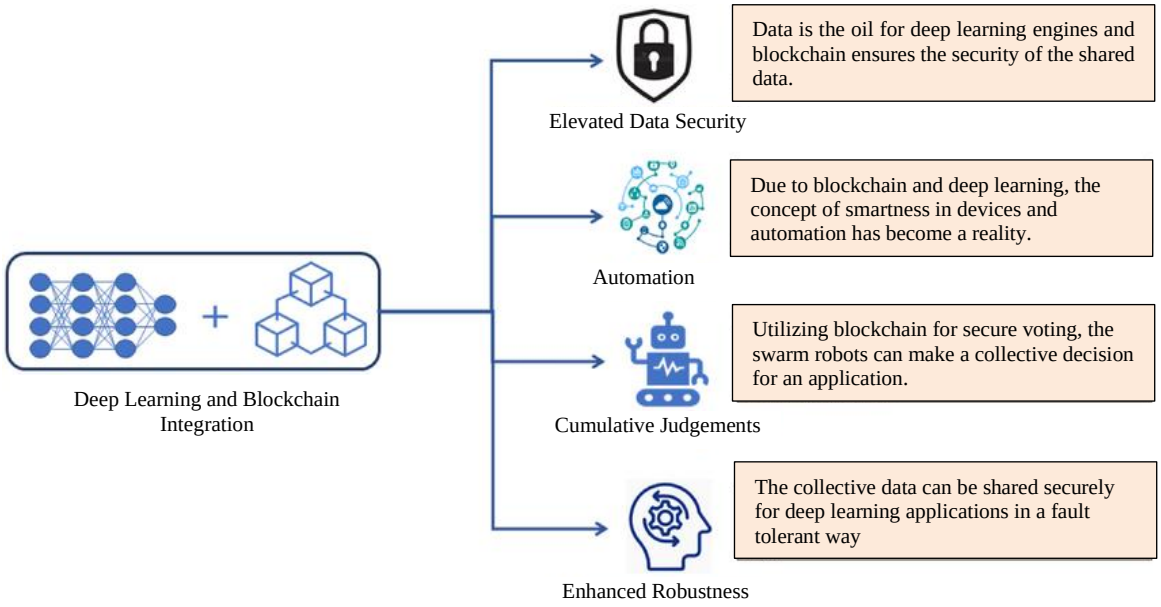

Figure 4. Schematics illustration of various merits resulted from the integration of block chain and deep learning technology.

Table 1. Deep learning along with blockchain features that helps in enhancing deep learning-based uses.

Deep learning	Blockchain	Outcomes
Scalable	Immutable	Flexibility in learning strategies
Data intensive	Cybersecurity	Data security can be enhanced
Layered	Transparent	Combined model update
Resource intensive	Integrity	Scalability can be enhanced

CONCLUSION

In conclusion, BCT is a ground-breaking invention that has the power to completely alter the way we handle data, perform transactions, and secure digital assets. It is a decentralized, open-source system that makes transactions more trustworthy by doing away with the need for middlemen. With the improvement of cryptocurrencies like Bitcoin and Ethereum, blockchain has already had a big impact on the financial industry, and it is predicted that it will have much bigger effects on other sectors.

Although the potential advantages of blockchain are obvious, there are still big problems that need to be solved before the technology can be fully utilized. Scalability problems, regulatory obstacles, and energy use issues are a few of these difficulties.

In general, BCT has a bright future, and as it develops further, we may anticipate even more cutting-edge use cases and applications. It will be fascinating to see how BCT evolves and what the future holds for it.

BCT HIGHLIGHTS

- The idea behind blockchain is to offer decentralized digital ledger technology, protect transaction records, and store data.
- Blockchain employs a network of nodes to validate transactions, and each block contains a record of many transactions.
- Cryptocurrency security and privacy are the main blockchain challenges.

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