**AN OVERVIEW OF BLOCKCHAIN TECHNOLOGY**

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 The block chain technology first emerged with the Bitcoin whitepaper, which was the first successful proposal to implement a decentralized digital currency with ability to execute completely non-reversible transactions without a trusted and centralized third party. Block chain is a chain of blocks that store information with digital signatures in a decentralized and distributed network. The features of block chain, including decentralization, immutability, transparency and auditability, make transactions more secure and tamper proof. Apart from crypto currency, block chain technology can be used in financial and social services, risk management, healthcare facilities, and so on. This paper presents a blockchain technology, describing its features, classification, challenges and applications.

**Keywords:**

Block chain , Supply chain, crypto currency logistics.

**INTRODUCTION :**

The Internet underwent several changes over the past two decades. Through blockchain technology and its components, it is possible to send or receive money over the Internet in a secure manner.

The next big item was online shopping.Blockchain is a distributed ledger technology (DLT) that is immutable and impervious to tampering. It is used in a shared and synchronized environment where all transactions are verified by users and are traceable. It makes it possible for a decentralized environment where all network participants can communicate safely without the requirement for a reliable authority. By using distributed consensus to validate and store all transactions, it does away with the requirement for a central authority.

**Block Chain Technology:**



One of the most controversial cryptocurrencies is "Bitcoin," the first blockchain-based cryptocurrency established in 2009. It enabled anonymous transactions without any governmental regulation. Blockchain is an immutable, time-stamped collection of records that is controlled by a network of computers. As a result, this system was given the moniker "blockchain" as, at its most fundamental level, it is nothing more than a collection of blocks. These blocks are connected to one another using cryptographic principles and are each secure. In the blockchain, "**block**" stands for "**Information**" and "**chain**" for "**Public Databases**".

**BLOCKCHAIN OVERVIEW:**

Blockchain technology is transparent and dependable because it is made up of interconnected blocks that make it easy to trace the history of transactions back to prior blocks. Each block contains both its own distinct ID and the hash of the previous block to guarantee transaction security. Each transaction has a timestamp, is added to the network in reverse chronological order, is linked to the previous block, and is irreversible.



**Fig: Block Chain work flow.**

Users within that network also confirm and log all transactions. Because of its general structure, blockchain is a "trusted technology"; the "consensus mechanism" is one of the most important components that contributes to blockchain's reputation for being reliable, secure, and transparent. A new block must be added to the system through the consensus process because blocks with records embedded in them are connected by hash values. With a collaboration mechanism, the adversary must compete with all users to create a longer branch for any update of an existing block in order to ensure the security of historical data.

**CHARACTERISTICS OF BLOCKCHAIN:**

The following qualities of blockchain make it distinctive and prospective for future industrial applications:

•**Decentralized:** The data on the system can be accessed, monitored, stored and updated on multiple systems.

**•Transparent:** Data is recorded and stored on the network, with consensus from the network and is visible and traceable throughout its lifetime.

**•Immutable:** Blockchain provides timestamps and controls to ascertain immutability

•**Irreversible:** For every transaction ever made, a certain and verifiable record is kept in each blockchain.

**•Autonomy:** Each node on the blockchain can access, transfer, store and update data by itself safely without third party intervention.

•**Open source**: Blockchain provides open source access to everyone in the network with sense of hierarchy.

**•Anonymity:** As data transfer occurs between nodes, the identity of the individual remains anonymous.

**•Ownership and uniqueness**: Every document exchanged on the blockchain stores its ownership records with a unique hash code

**•Provenance**: Every product has a digital record document in the blockchain which proves its authenticity and origin.

•**Contract automation** : It is a small computerized program to help execute contract. It replaces the need of a usual contract with providing better security and lower transaction costs. Smart contracts are usually coded to include conditions for rules, penalties and actions that will be applied for all the parties involved in the transaction. Smart contracting supports quick response operations in supply chains.

**BLOCKCHAIN STRUCTURE**

The Blockchain is made up of a series of blocks that operate as a public ledger-like database for all transactions. These blocks are connected to one another by a reference hash that is a part of the parent block, the block that came before. The genesis block, which has no parent blocks, is referred to as the initial block. The block header and block body make up a block. Data such as block version, parent block hash, Merkle tree root hash, timestamp, and nBits are included in the block header.



The block body must include a transaction counter and transactions. Transactions are the list of recorded transactions in the block, and the transaction counter indicates how many transactions have come after. The maximum number of transactions that can be stored in a block will depend on the block size and the volume of each transaction. Blockchain uses a symmetric cryptography approach to check the authenticity of transactions. Asymmetric cryptography-based digital signatures are employed in unreliable environments, like the blockchain network. Each participant in this process has a private key and a public key pair.

The public key, which is dispersed throughout the network and is available to everyone, aids in decrypting the subsequent transaction while the private key is used to sign or encrypt the transaction.

**BLOCKCHAIN APPLICATIONS**

Blockchain technology has a wide range of potential uses. It's critical to realize that bitcoin is not the same as blockchain; rather, it is one of the technology's most widely used applications. Bitcoin is a digital currency that uses cryptography and is traded through the open, public, and anonymous blockchain network. However, according to experts, this technology can be used to identify answers for a variety of issues, including governance, supply chains, voting, healthcare, and the management of identities and other personal information. Additionally, some futurists assert that blockchain may have an impact on the digital world akin to that of the internet. Since blockchain technology is still in its infancy, there is a lot of untapped potential. Block chain has so many application in every sector, following are the some of the applications.

 **Real Estate :**

The real estate sector could be completely disrupted by blockchain technology. Real estate contracts, escrows, and property records will be possible without the use of title firms or attorneys thanks to the development of smart contracts by stakeholders. In the future, it might be possible for a buyer to put a home in their shopping basket and finish the transaction online.

The seller will be compensated in cryptocurrency and the buyer will receive the title thanks to the blockchain. It's inevitable that how money is handled and transactions are conducted will change, and that shift is already happening. To succeed in the blockchain era, brokers will need to modify their business models to comprehend smart transactions.

**IOT**

All IoT devices are given the ability by blockchain to increase security and bring transparency to their interconnected ecosystems. Smart homes are a prominent example of how blockchain technology is being used in the Internet of Things.While IoT makes it possible to remotely control home security systems from smartphones, the typical centralized approach to transferring information produced by IoT devices lacks security standards and information ownership.

Blockchain technology has the ability to advance the smart home by addressing security concerns and getting rid of centralized infrastructure. To ensure that the data collected from smart devices is unaltered, the organization uses biometric and blockchain security. The blockchain is used to store private user information including fingerprints, voice recognition, and facial recognition. When data is saved on the blockchain, it becomes unchangeable and is only accessible to a limited number of people.

**Supply chain**

Businesses are looking for technology that will not only make supply chain management simpler, but also allow them to automate a variety of supply chain-related business operations. This is because new expectations from end users and other stakeholders have caused supply chains to become more convoluted. Due to its many and varied applications, many supply chain suppliers believe that blockchain technology may be leveraged to successfully handle their issues.A wide range of operations can be automated through the use of blockchains in the supply chain vertical, including supplier payments, cold chain monitoring, contract bid execution, product status tracking at the production stage, and using smart contracts to share surplus solar power.

**Government**

The necessity for centralized government institutions is being gradually replaced by blockchain technology, but it is most likely that in the coming years, the rivalry between governments and cryptocurrencies will reach its peak.However, governments are constantly pursuing the use of blockchain services to enhance and restructure operational procedures since they are aware of the potential that blockchains might unsheathe. For a variety of reasons, several governments have tended to use blockchain technology.To promote transparency and reduce corruption,some nations are implementing their own national coins. Additionally, blockchains can be utilized to create immutable voting systems that disprove the existence of fraud and forgery. Blockchains can also be used to improve tax management and identity management.

**Cyber security:**

The potential for hackersto exploit businesses has increased enormously as corporations become increasingly reliant on the Internet and other technology for creating revenue streams and defining business models. The demand for effective cyber security solutions is at an all-time high in this state of amazement. Blockchains, with their distributed ledger technology, fundamentally improve cyber protection. Depending on the underlying properties of operational resilience, data encryption, auditability, transparency, and immutability, blockchain platforms can prohibit fraudulent actions through consensus mechanisms and detect data tampering. Unlike the conventional database-driven transactional structures, distributed blockchains offer greater security since they prevent a single point of failure.

**Social Media:**

Social media networks had just recently absorbed people from all sides. These platforms are beginning to lose users as a result of certain transgressions, such as personal data breaches and inadequate user recompense. The statement that "social media is losing its edge" is accurate. Here, blockchain comes to transform the social media industry. Social media platforms have been improved to a whole new degree by technology. Blockchain technology offers a mechanism by which users can exert more control over the protection of personal information while also potentially earning money for the viral content they create andits decentralized and distributed ledger constitution.Blockchain has the potential to take the fundamentals of social media to a whole new level.

Technology has the potential to completely reimagine the way that information and content are privately handled and monetized.

**Artificial Intelligence**

One of the most formidable and deadly technologies ever conceived could be AI built on top of blockchains. Decentralized Autonomous Organizations (DAO) could be created by decentralizing AI.DAOs are businesses that can function independently and decentralizedly thanks to smart contracts, without a single entity controlling everything and making all the choices.When carried out properly, an AI DAO may eventually replace human design by learning from data to optimize itself far more effectively than was possible. Together, blockchains and AI, or what we might refer to as a "decentralized AI," can open up new avenues for data security, data monetization, and intelligent algorithms.

**Health care**

One of the most competitive sectors in the world, healthcare will most certainly adopt or be driven by blockchain technology. It is what the blockchain technology will look like in the future. Blockchain may be used throughout the whole healthcare value chain because it is the supply chain's future business model.All of its stakeholders—from patients and customers to providers, administrators, and healthcare institutions—will gain from the technology's fundamental streamlining and transformation of everything from medical records and payments to processing and analytics. Healthcare systems will achieve the following by integrating blockchains:

**Interoperability**: Data will be stored in a single format and can be shared seamlessly.

**Decentralized data storage**: A single technology that would handle every data of patients.

**Power to patients**: Patients are would-be owners of their own data. They will have the power to choose with whom their personal health records are to be shared.

**CHALLENGES OF BLOCKCHAIN TECHNOLOGY**

 One of the most popular buzzwords in business and technology right now is blockchain. With its capacity to operate without a centralized authority or middleman, it is regarded as the technology that will revolutionize the finance industry. Blockchain is also seen to be advantageous for other businesses because to its capacity for storing tamper-proof data and managing a massive trail of records in a productive manner. However, blockchain has its limitations and is not practical for many different company models, much like previous new technologies.

**Scalability**

Due to the significant processing demands required to validate transactions, blockchain networks can be slow and inefficient. The capacity of blockchain networks to process and validate transactions and applications in a timely manner is stressed as the number of users, transactions, and apps rises. Blockchain networks are therefore challenging to deploy in applications that call for quick transaction processing times. The consensus methods used by traditional blockchains like Bitcoin and Ethereum, such as proof-of-work and proof-of-stake, can be slow and resource-intensive. Because of this, these networks' throughput constraints for transactions frequently cause congestion and high transaction costs.Scalability problems have been addressed in a number of ways, including scaling systems for off-chain channels that enable quicker and more affordable transactions.And while progress is being made by blockchain experts, creating scalable, effective, and decentralized blockchain networks is still a problem that requires further research.

**Energy Consumption**

A blockchain network's transaction validation procedure uses a lot of computational power, which in turn uses a lot of energy. This has given rise to worries about carbon emissions and the effects of blockchain technology on theenvironment. Alternative consensus mechanisms, including PoS, which need substantially less energy, have been employed by several blockchain systems. The energy usage of the Ethereum network is also reduced through programs like Ethereum 2.0. Even if these initiatives show promise, the blockchain community must keep looking for ways to reduce energy use and provide ecologically friendly solutions.

**Security**

Despite being regularly mentioned as one of the technology's main benefits, blockchain network security is not without its problems. Blockchain networks have already experienced security failures and hacker attacks; these problems can result in monetary losses and harm to the integrity of the network.Businesses are working to make blockchain networks and apps more secure in an effort to lower risks. Their security features include formal smart contract verification to help reveal any weaknesses, the use of multi-signature wallets for storing and managing digital assets, and other measures.As blockchain technology advances, security of users, assets, and transactions remains a concern.

**Complexity**

The complex blockchain technology is difficult to deploy and manage, requiring a high level of technical expertise. Technical problems may hinder the adoption of blockchain technology and deter developers and users alike. The complexity of blockchain technology could lead to ineffective implementation practices.This issue is being addressed through the development of user-friendly interfaces, accelerated onboarding processes, and instructional materials that demystify the complexities of blockchain. It is still difficult to develop standardized protocols and frameworks that lower entry barriers for users, assets, and transactions. Collaboration between government agencies, academic institutions, and business personnel should increase in order to achieve this.

**Interoperability**

Another major issue facing the sector is interoperability, or the capacity of various blockchain networks to connect and communicate with one another. Currently, there are a variety of blockchain systems available, each with their own protocols and standards, and they frequently do not interact properly. Since people and businesses may need to use a variety of tokens or cryptocurrencies to communicate with various networks, the lack of interoperability might result in inefficiencies. Additionally, this fragmentation may make it more difficult to collaborate, discourage innovation, and allow for the inefficient transfer of information and value between various blockchain ecosystems.. To make full use of the promise of the technology, interoperability between various networks must be fostered as the blockchain sector expands and diversifies. The industry may work toward developing a unified, effective, and inclusive digital environment that benefits users, developers, and companies by dismantling silos and encouraging collaboration between multiple blockchain platforms.

**FUTURE SCOPE OF BLOCKCHAIN TECHNOLOGY**

Blockchain, in the opinion of the researchers, has enormous promise in both academia and business. We have briefly covered a variety of potential uses for blockchain technology in this section. Blockchain performance to entice investors with the prospect of enormous profits. Before incorporating this technology into a business solution, it is essential to understand whether it satisfies the criteria. As a result, there should be a common testing procedure for blockchain-based solutions to evaluate the benefits and drawbacks. Two phases the standardization phase and the testing phase could be distinguished in this process. Based on a set of precise criteria, the first phase will evaluate the developers' claims on their blockchain solutions. The testing phase is used to evaluate how well the blockchain-based solution works. For instance, the operation of the blockchain-based system is important to the owner of an online retail company. In order to assess the throughput, capacity, and latency of the platform used for the acquired solution, some testing and standardizing techniques should be in place.

By registering new inventions, proof ofconcepts, and drawings using blockchain technology, businesses may create a digital trail of their creations and produce certificates that can be used to demonstrate the legitimacy, existence, and ownership of any intellectual property asset. All notarized information, including trade secrets and copyright claims, might be kept private and secure by utilizing the special cryptography layer.

Big data analytics is also thought to work well with blockchain, particularly when it comes to data management and analytics. Blockchain technology could be used for data management to store data in a decentralised, safe manner. Additionally, the blockchain's immutability feature can guarantee the data's veracity. For instance, it would be challenging to alter patient health records recorded in the distributed ledger, and no one could take such information without the owner's permission. Data analytics could be applied to blockchain transactions. The trading patterns and behaviors of the potential partners in the blockchain network can be ascertained through this procedure. Any copyright claims could be kept secure and confidential.

Smart contracts are one more new application area for blockchain. The blockchain node has this protocol installed as a piece of code. A message included in the transaction starts the execution of a smart contract. Different platforms for creating smart contracts have recently started to emerge. Blockchain-based smart contracts can be used in a variety of contexts, including banking services and IoT platforms. There are two categories of smart contract research: development and evaluation. The creation of a platform for smart contracts is possible. Car auctions, online trade, and other solutions based on smart contracts are all possible thanks to Ethereum's architecture. Code analysis and performance are both included in evaluation. It has been proven that even a small bug in developing smart contracts could cause a disastrous impact.

 **CONCLUSION**

The blockchain's potential and advantages are covered in this essay. Also described are the transaction procedure, system architecture, and application areas. For the purpose of developing more practical and efficient industrial applications that may fully benefit from the usage of blockchain and accomplish the intended goals, there are still a number of unresolved challenges that require further research and analysis. Security, privacy, scalability, energy use, integration with other systems, and, more specifically, regulatory issues are some of the outstanding issues in this list. Further study in this field is required to address these issues and close the gaps for more efficient, scalable, and secure blockchain industrial applications.