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Blockchain Technology: An Overview on Its Working Applications

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Abstract

Blockchain technology is one of the enhanced technologies in this era, operating as a structural database that accumulates and stores information in discrete blocks. These blocks are interconnected, forming a chain where data is securely stored. Blockchain employs enhanced security measures to protect against tampering, manipulation, or hacking attempts. A main aspect of blockchain is its decentralized system. When a transaction occurs, approval from authorities within the business network is required for recording. This decentralized approach ensures that data cannot be easily modified without authorized consent. Furthermore, blockchain technology is highly efficient, aiding faster transaction processing within business networks. The data is chronologically immutable, ordered by time, facilitating quicker audit processes and efficient transaction recording for enterprises. This technology is usually used for recording transactional records between parties, creating a chain of interconnected blocks. Its impact is particularly notable in payment processing and financial transactions, including the realm of cryptocurrency. Moreover, cryptocurrency, a digital currency facilitated by blockchain technology, operates worldwide through a decentralized system enabled by cryptography. Transactions, including buying and selling of instruments like Bitcoin or Ethereum, must occur transparently, a feat achieved through blockchain's secure processing and recording mechanisms. Hence, blockchain technology streamlines processes, enhances data security and automates transaction recording with authorized oversight, making it an essential advancement in today's digital world.

Keywords: Blockchain technology, transactions, network, cryptocurrency, database, security, distributed network, decentralized system, applications

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INTRODUCTION

Blockchain technology can be described as a decentralized and distributed ledger technology that records information chronologically within a business network or specific community (Figure 1). It functions as a digital ledger, storing records of various transactions that occur in a peer-to-peer network. In this technology, no individual or entity has the power to alter or delete existing data or recorded transactions, making it virtually impossible to hack or attack the blockchain system. The use of distributed ledger technology in blockchain integrates transparency, fast auditing, immutability, and security, creating a tamper-proof environment [1].

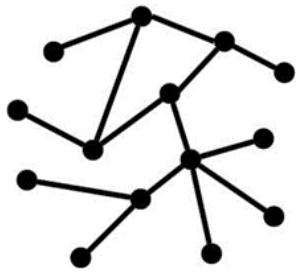

Figure 1. Decentralized system.

Blockchain technology has garnered interest in Byzantine fault-tolerant (BFT) systems, which are part of distributed systems ensuring smooth node functionality. Unlike traditional distributed databases, blockchain technology provides data provenance and enables federated data processing in suspicious or malicious environments, validating a wide range of decentralized applications in finance, gaming, healthcare, and social media [2].

In the realm of security, traceability, and control over digital asset transactions, blockchain stands out as a cutting-edge technology [3]. It is poised to eliminate intermediaries from various digital asset transactions, functioning akin to a digital ledger with distinct characteristics:

- Blocks can only be appended. Alteration of blocks is prohibited [4].
- Editing and deleting blocks is not allowed.
- The validity of a transaction depends on prior transactions [5]. Transaction processing occurs only upon full verification.

Furthermore, blockchain technology is categorized into three phases:

1. *Blockchain 1.0:* This phase encompasses day-to-day transactions, with cryptocurrency serving as a prominent example.
2. *Blockchain 2.0:* It encompasses the entire economic market, expanding beyond traditional transactions to include stocks, government bonds, and smart contracts.
3. *Blockchain 3.0:* E-governance, digital health records, digitally vote counting, culture and digital, science, literacy and arts fall under Blockchain 3.0, which is apart from Blockchain 1.0 and Blockchain 2.0.

WHAT IS BLOCKCHAIN

The name “blockchain” derives from its structure, combining “block” and “chain.” Blocks are small data chunks where information is stored, secured using hash signatures, and linked together to form a chain [6]. In essence, blockchain is a structural data interconnected with each other, constituting decentralized storage of information in a distributed network [7]. Copies of the blockchain are stored in various nodes of a peer-to-peer network without central management control [8]. This technology is characterized by enhanced security, preventing users from altering, modifying, or deleting any block or information inside it without proper authorization from the blockchain authority [9, 10].

Further, blockchain technology consists of four types:

1. *Public blockchain*
   i. This type is a distributed information system that records transactions without the need for any central authority's permission. It operates openly and transparently, with decisions made through decentralized consensus mechanisms.
   ii. *Example:* cryptocurrencies like Bitcoin, Ethereum, Litecoin, etc.
2. *Private blockchain*
   i. It is also a distributed network but limited to a specific blockchain network.
   ii. Private blockchains are used by organizations or enterprises where a limited number of nodes have access.

iii. Security in private blockchains is higher compared to public ones, with accessibility controlled by the organization.
iv. *Example:* voting, digital identity, supply chain management, etc.

3. *Hybrid blockchain*
   i. Hybrid blockchain is a mixture or combination of both private and public blockchains. Transactions can be verified in both private and public blockchain network. This type of blockchain is mainly developed to reduce the challenges of both types of blockchains and increasing the efficiency of both type of blockchains. This type of blockchain can be deployed by the organization who does not will to deploy private blockchain nor the public blockchain.
   ii. *Example:* Dragonchain.
4. *Consortium blockchain*
   i. Owned by a group of companies from different sectors, consortium blockchains integrate data from multiple sources.
   ii. Only selected or assigned nodes in the consortium have authority to verify and validate transactions.
   iii. *Example:* Healthcare, IBM, Marco Polo.

HOW BLOCKCHAIN TECHNOLOGY WORKS?

In simple words, blockchain consists of blocks in which information is stored and these blocks are connected to each other in chronological order to form a chain. A single block contains three things namely data, hash, and hash of the previous block. Every block in the chain is encompassed with a cryptographic hash. The unique and unrepeated number is given to an encrypted block, which is called as Nonce that can be utilized only once when selected by the miners to solve a cryptographic puzzle so that the next block could be generated in the chain.

In Figure 2, we can understand the clear pictorial representation of working of the blockchain technology, the breakdown of the image can be understood by the following steps:

1. The user or any entity requests the transaction.
2. In the group of nodes, which is called network, the transaction is broadcast from one peer to another peer.

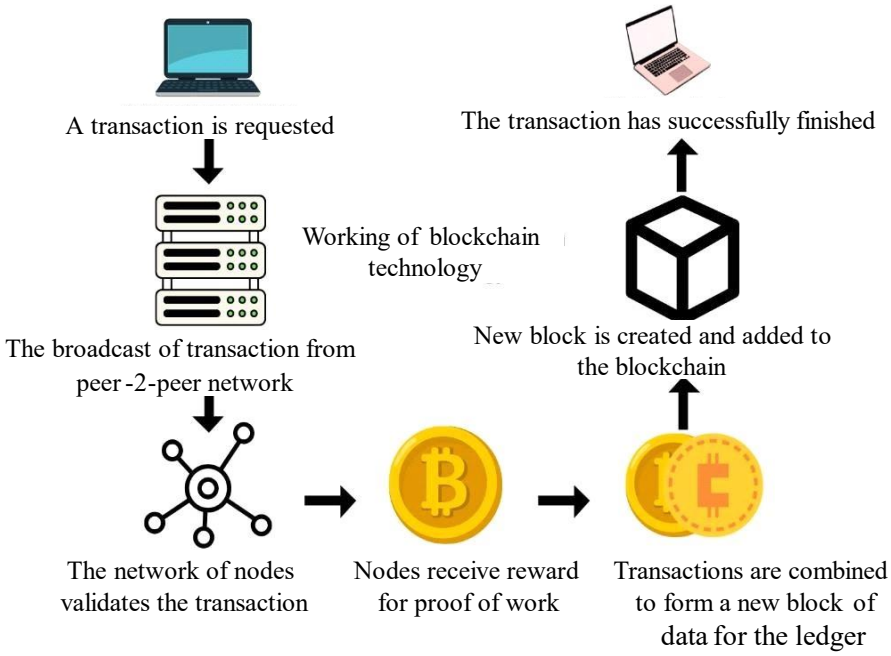

Figure 2. Graphical representation on working of blockchain technology.

3. The nodes inside the network uses a specified algorithm to validate the transaction and the user's status.
4. The further transaction is combined with other transactions once the verification is completed to create a new block of data.
5. The new block of data is created and added to the existing blockchain.
6. The last step shows the transaction is successfully completed.

APPLICATIONS OF BLOCKCHAIN TECHNOLOGY

In this emerging era, blockchain technology is widely scattered all over the globe. It is widely used technology which has the great contribution in the field of technology. Blockchain technology can be used in various fields like transportations, finance, industries, cloud computing, wireless networks, energy sectors, internet of things, etc. Some of the important fields where blockchain technology is highly used or needed are.

Healthcare

Healthcare is one of the important sectors universally. The distributed and sprinkled medical records caused by the transfer among various medical institutions have become a crucial problem that slows down the healthcare industry. Blockchain technology is useful in healthcare environment and helps in management of electronic medical records, remote patient monitoring, health data analytics, biomedical research and education, pharmaceutical supply chains, health insurance claims, and other relevant areas. The prime motive behind the implementation of blockchain technology in the healthcare sector was to be identified as data integrity, access control, data logging, data versioning, and nonrepudiation. The blockchain allocates an opportunity to build a platform for authentic and relevant recording. Using the blockchain technology, highly fragmented healthcare records can be collided to track personal health records.

The major problem is to maintain and access all the records coming from different institutions, the solution for this problem is combination of artificial intelligence and healthcare information technology which will solve the good number of problems in the healthcare sector.

Cybersecurity

Cybersecurity is a paramount sector due to its crucial role in ensuring data privacy and protection, safeguarding user data from theft or unauthorized modifications.

Cyberattacks can take various forms, such as viruses, Trojans, and ransomware attacks. To illustrate the application of blockchain technology in cybersecurity, consider the following scenario: In a non-blockchain environment, let us say Person 'A' initiates a transaction to send money to Person 'B'. As this transaction unfolds, the details are stored on a cloud-based system. However, this cloud system is vulnerable to attacks by hackers or groups, potentially resulting in theft or unauthorized access.

On the contrary, in an environment utilizing blockchain technology, when Person 'A' sends money to Person 'B', the transaction details are securely recorded in blockchains. These blockchains utilize cryptography to protect the transaction details, ensuring privacy and security.

Therefore, blockchain technology plays a crucial role in enhancing cybersecurity by providing a secure platform that keeps data private and theft-proof. This application of blockchain technology strengthens cybersecurity measures, offering robust protection against cyber threats.

Internet of Things

The internet of things (IoT) refers to a network of physical devices or objects connected to network connectivity, enabling them to exchange data with other devices over a connected medium. This connectivity aims to enhance efficiency, productivity, services, and facilitate fast data transfer.

When combining the IoT with blockchain technology, a model is created to ensure reliability, security, and a permanent method of recording data processed by smart devices. Blockchain enhances IoT by increasing security and transparency within the IoT ecosystem. IoT devices, which are smart devices, send data to private blockchain ledgers to ensure that the data sent is included in shared transactions along with other tamper-proof records.

The integration of blockchain technology with IoT offers a precise solution for multiple challenges faced in IoT applications. These challenges include data storage, timestamps, sensor integration, supply chain management, identity management, smart healthcare, and smart homes. This combination not only strengthens security and transparency but also streamlines processes in various IoT applications, contributing to more efficient and reliable operations.

Cryptocurrency

Blockchain technology serves as a foundational pillar behind the success of cryptocurrency systems, ensuring enhanced security and data privacy on a global scale. Within the realm of cryptocurrency, blockchain technology operates through a ledger that comprehensively records all transactions and activities, thereby validating the ownership of various currencies. The speed of cryptocurrency transactions, occurring in milliseconds, allows for rapid auditing through blockchain recording. A cryptocurrency transaction undergoes validation once added to the blockchain network, making it irreversible, akin to payment apps like Gpay or Paypal. The robust security measures and firewall surrounding blockchain prevent unauthorized access, ensuring that hackers cannot modify information within blocks. Furthermore, blockchain's transparency enables any entity online to scrutinize transactions within the cryptocurrency unit.

OBJECTIVE OF THE STUDY

In daily life, blockchain technology is utilized widely. The goal of blockchain technology is to automate transaction recording and minimize human intervention in blocks that link to form a chain. The goal of the study is to gather a substantial number of relevant facts and material that readers can readily understand in order to motivate them to dig deeper into the subject.

This research paper deals with the following objectives:

1. To know the information about blockchain technology.
2. Applications of blockchain technology.
3. To know how the blockchain technology works.
4. Blockchain technology used in cryptocurrency.

LITERATURE REVIEW

The research paper focuses on blockchain technology, information about blockchain, its working, types, applications, etc. The aim is to provide detailed knowledge about the topic by making simple and proper research paper which may be helpful for readers. The topic is chosen because blockchain is one of the rapidly growing sectors around the world which is very helpful to achieve solutions for recording data and enhancing the data with high security.

The overview of research paper includes the fine knowledge about the blockchain technology and minor points related to the topic. Mapping of relevant subtopics to another topic is also analyzed and mentioned in systematic way. The organization of research paper is structured in a top-to-bottom approach where the direct information is not provided rather step by step topics related to each other is laid down chronological order which makes easier to understand.

Numerous studies have underlined blockchain's key role in improving security, transparency, and data integrity within financial transactions, notably focusing on cryptocurrencies like Bitcoin and Ethereum. Researchers have delved into blockchain's decentralized nature, highlighting its capacity to reduce reliance on intermediaries and foster trust in transactions.

Moreover, academic literature has explored blockchain's applicability beyond finance, including in supply chain management, healthcare, and governmental sectors. Researchers have probed how blockchain can streamline processes, cut costs, and boost efficiency in these realms through its absolute record-keeping and secure data sharing features. Overall, the growing interest in blockchain technology evident in literature reflects its capabilities not only in fortifying financial systems but also in catalyzing transformative changes across sectors by ensuring secure and transparent data management.

RESEARCH METHODOLOGY

Systematic research was conducted to get valid and informational data. The research methodology used for this research paper is broken down in the following steps:

- *Type of research*
  - A qualitative research has been conducted to write the research paper.
- *Data collection sources and process*
  - The data collected for this research paper is from web, other research papers and articles.
  - The data is collected and stored in Microsoft Word known as the secondary data.
- *Evaluation and data analyzation*
  - The secondary data collected is analyzed and evaluated with keen reading and understanding the topic deeply.
- *Inclusion criteria*
  - Latest data is used to read and write down the research paper.
  - Topics related to blockchain and topics that are closely mapped to other topics are included.
  - Open access articles and web content are used to read the data.
- *Results*
  - What is blockchain?
  - Working of blockchain
  - Applications

CONCLUSION

In this research paper, an extensive and in-depth overview of blockchain technology, a pivotal technology impacting various business sectors and beyond, has been presented. Blockchain has become a significant technology in business areas and many other fields, one of the common mechanisms which relates to all sort of fields are ‘transactions’, the overview of blockchain technology has been stated to understand what exactly blockchain technology is.

The detailed mechanism of working of blockchain is also explained in clear and accessible manner which makes the readers understand and grasp its intricate workings easily. Blockchain technology is an emerging technology that is applicable in every field. Moreover, the benefits and challenges that are associated with blockchain are also addressed with a balanced perspective. Few sections in the paper also have graphical representations, which make the research paper interesting and readable.

Thus, the paper follows qualitative research methodology, which focuses on the data and the information of the topic. All the important points are covered to provide detailed knowledge about the blockchain technology with diagrams. Notably, graphical representations enhance the paper's legibility and engagement, making complex concepts more accessible to readers. The qualitative research methodology employed prioritizes data and information accuracy, ensuring that all key aspects of blockchain technology are covered comprehensively, including diagrams for enhanced understanding.

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