

“Blockchain and Its Applications in the Real World”

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Abstract - Blockchain technology has the implicit to reshape and contribute to an enhanced quality of life. Blockchain technology has surfaced as a important force with the eventuality to reshape traditional paradigms and significantly ameliorate the quality of life. This exploration paper dives into the different practical applications of blockchain. Blockchain plays major role in cryptocurrencies. blockchain boost the sectors ranging from finance and supply chain operation to healthcare and governance. By implementing translucency, security, and data integrity, blockchain is at the van of fostering trust in the digital age. This study examines both the openings and challenges that blockchain presents in real-world, emphasizing its capacity to revise the way we interact with the world around us.

Key Words: Blockchain, Applications, Smart contract, Healthcare, Finance, E-governance.

1. INTRODUCTION

Blockchain is a technology introduced in 2008 by a person using the name Satoshi Nakamoto. Satoshi Nakamoto's revolutionary whitepaper on Bitcoin, the first practical implementation of blockchain, introduced a groundbreaking conception, a distributed ledger able of recording deals in an incorruptible and immutable manner. Since that momentous publication, blockchain has enormously evolved beyond its origins in cryptocurrency, web technology and real-world applications. blockchain is implemented in finance, supply chain management to healthcare and E-governance. In the realm of finance, by offering secure, transparency, and cost-effective deals, blockchain led to digital currencies like Bitcoin, Ethereum. The impact extends to supply chain operation, where blockchain ensures end-to-end visibility and responsibility, combatting issues similar as fake products and inefficiencies. In the healthcare sector, usage of Blockchain technology led to provision of secure and interoperable electronic health records (EHRs). This invention streamlines data sharing among healthcare providers, leading to more patient-centric care. In the Governance sector, blockchain driven revolution, promising transparent and tamper-resistant voting systems, as well as secure digital individualities.

The birth of blockchain technology can be traced back to the enigmatic Satoshi Nakamoto, whose seminal whitepaper, "Bitcoin A Peer-to-Peer Electronic Cash System," published in 2008, laid the foundation for a technological revolution.

Nakamoto's visionary conception of a decentralized, tamper-resistant tally surfaced as a direct response to the vulnerabilities exposed by the global financial crisis. The initial implementation of this groundbreaking technology, Bitcoin, made its debut in 2009 as the world's first digital cryptocurrency. It introduced a peer-to-peer electronic cash system. This invention marked a vital moment in the history of digital currencies, as it showcased the eventuality for a secure, transparent, and borderless system of value exchange. The arrival of blockchain technology didn't simply address the failings of being fiscal systems, it ameliorates real-world operations that extended far beyond its cryptocurrency origins.

2. BLOCKCHAIN ARCHITECTURE

2.1 BLOCK HEADER

Block header acts as the identification for a particular block. It is periodically hashed by miners by changing the nonce value. It contains meta data and information about the transactions.

2.2 PREVIOUS BLOCK HASH

Previous Block hash is used to connect the present block to the previous block (ith block with the ith-1 block). It acts as a reference to the parent block.

2.3 TIME STAMP

It is the date of creation for digital documents. It helps in arrangement of the blocks in blockchain chronologically. It is represented as a string of characters.

2.4 NONCE

Nonce is a random number used in the mining process only once. In short Nonce is referred to Number used once. Nonce value is changed every time when a miner mines the block to find a valid solution.

2.5 MERKLE ROOT

Merkle Root summarizes all the transaction hashes in a block into a single hash, which is then stored in the block header. This results in efficient way of verify if a transaction is included in the block or not, enhancing the blockchain's efficiency and security

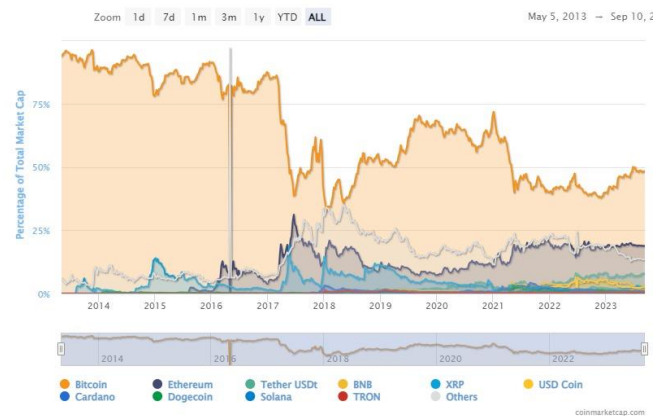
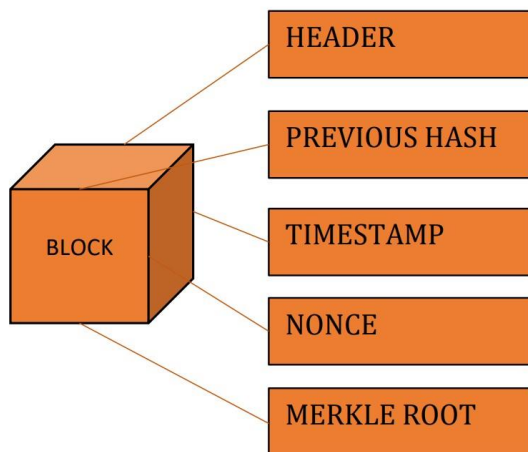


Figure 3: Individual proportions of top 10 crypto assets

3. BLOCKCHAIN - CRYPTOCURRENCY

Cryptocurrencies are known as digital or virtual form of currency. They are a type of digital currency which people can make their transactions digitally through online platforms. Cryptocurrencies will not have any enacted or intrinsic value they are simply tokens, what people are willing to pay for them in the market. This is in contrast to national currencies. There are a number of cryptocurrencies but the most well-known of these are Bitcoin and Ether. One of the most active areas of the blockchain is in the financial sector especially in the field of cryptocurrency.

Bitcoin has been called as the king of cryptocurrency. Within two years of its quiet launch in 2009, Bitcoin grew to comprise billions of dollars of economic value despite only brief assessment of the system's design. Since the time more and more research has been done to find hidden but important aspects of the system, discover potential attacks, suggest better alternatives, and point out tough challenges we'll face in the future.

Below graphs shows the distribution of the ten largest cryptoassets, with Bitcoin maintaining its position as the largest by market cap. The total market cap of cryptocurrency ranges from approximately \$500-600 billion to a peak of \$1.5 trillion, source – coinmarketcap.com.

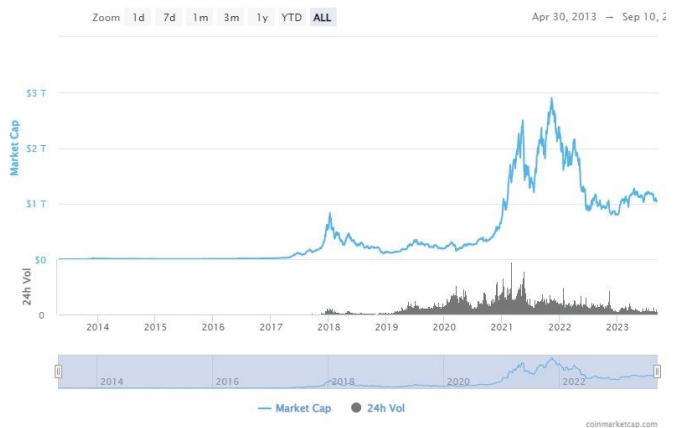


Figure 4 - Total marketcap of all cryptoassets

3.1 BLOCKCHAIN – TRANSACTION PROCESS

1. Transaction initiation - When a user wants to send cryptocurrency, user creates a digital message or a record this record or message includes required information like the public key of the recipient, amount of cryptocurrency to be sent with timestamp.
2. Broadcasting - Message is Broadcasted to the entire network. This message is sent to all nodes in the network for validation
3. Pending state - Transaction joins a pool of pending transactions waiting to be included in the next block this is often referred as mem-pool or memory pool
4. Creation of Block - Miners, nodes in the network, compete to create a block of transactions. Creation of block is done by solving a complex mathematical problem, often referred to as the PROOF OF WORK. The creation mechanism may vary based on the Consensus mechanism.

5. Validation - once the Block is created, it contains a set of pending transactions. After creation the block is Broadcasted to the network
6. Network Consensus - Other nodes in the network verify and validate the newly created block . They check the transactions and ensure that the miner followed the network rule .
7. Confirmation - Cryptocurrency often wait for multiple confirmations from the network nodes . Each node's confirmation is considered as a single confirmation. Bitcoin's minimum confirmation for the block to be validated is six. Each new block is then added to the Blockchain.

3.2 Non-Fungible Tokens (NFTs)

Digitalization of assets can be done by adding a layer of uniqueness and ownership verification . Digital asset is an advantage of the blockchain . Digital assets are named as Non-Fungible tokens(NFTs), unlike traditional cryptocurrencies like bitcoin which are fungible and interchangeable, NFTs are not fungible , cannot be divided or changed and they represent ownership of a specific item or piece of content . NFTs are mostly represented in the form of digital arts , collectibles , music or virtual estate.

Uniqueness of NFT is the reason behind the digitalization of assets in the form NFTs. Each NFT has its own properties that differ from other NFTs . No one can modify or duplicate the NFT or ownership of the NFT. NFTs are issued by a smart contract . The smart contract can create NFTs and assign them to owner. Ownership of the NFT is done by mapping it to the owner's address. Ownership can be transferred by sending the NFT to receiver . NFT can also be destroyed only if the creator includes a functionality to burn known as "burn" in the smart contract.

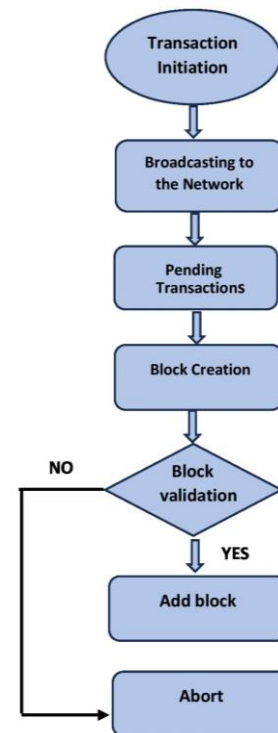


Figure 1 : Blockchain Transaction process

4. BLOCKCHAIN – APPLICATIONS

Blockchain technology is implemented in several operations similar as finance, supply chain operation , healthcare ,E-governance, and property rights. In finance, operation of Blockchain promises secure and transparent deals, potentially reducing the need for third-party and reforming payments styles. In supply chain, Blockchain is enforced by recording and validating each step transparently, reducing crimes and enhancing trust, and enabling real- time traceability. In healthcare, it helps secure electronic health records(EHRs) and data sharing among hospitals , doctors and case- care center. E-Governance made easy by enforcing blockchain for transparent voting systems and securing digital individualities, while property rights are strengthen through blockchain's asset verification and content protection.

4.1 BLOCKCHAIN – FINANCE

Blockchain technology is disrupting the financial sector by providing transparency, secure, tamper-resistant transactions. In the traditional financial system, money is sent to the receiver from the sender by the means of third-party or banks.

Sender is dependent on the third-party system which is a centralized system. By implementing the blockchain technology we can revolutionize the financial sector by introducing the decentralized system with no third party

authority .Blockchain based cryptocurrencies like Bitcoin, Ethereum have gained attention as alternative forms of digital money, replacing the banking system. Blockchain is streamlining cross-border payments, reducing the transaction time from days to minutes. Blockchain also facilitates peer-to-peer lending platforms ,with decentralized Finance (De-Fi) platforms emerging, the traditional finance system are facing a pushback. One of the most significant impacts of Blockchain is its transparency , every transaction is recorded on the blockchain is visible to all the participants in network. Transparency is crucial in auditing , fraud detection .Smart contracts are introduced , a self-executing agreements powered by blockchain reducing the need for intermediaries . Blockchain's immutable ledger ensures that once a transaction is recorded , it cannot be altered or deleted which results in enhancing the security and integrity of financial data.

4.2 BLOCKCHAIN – HEALTHCARE

In the healthcare there are many network connection of applications that run on block chain technology for privacy and security which includes the storing the data , exchanging the data from many hospitals , and also the data from pharmaceutical companies which are having wide range of transportation , physicians. In Early traditional systems the data is stored in physical format likewise paper documents , files in the centralized databases, These physical records face several challenges such as vulnerability to loss, damage, and unauthorized access. Retrieving the data can be time-consuming which leads to delays in patient care and decision-making and the current condition of the patient may vary from the records stored .To overcome this , a new proposal is made by the use of Blockchain technology . Blockchain enhances the healthcare sector by enabling the secure transfer of patient medical records, improving drug supply chain management, and ensuring the safe and efficient way of handling genetic code information. A person's health records are sensitive information and needs to be dealt with high security .By implementing Blockchain we can store the Health records by encoding using cryptographic hash functions and storing them in Blockchain, where a private key is provided which would allow only specific individuals to access the records. Patient records stored on the blockchain can be seamlessly transmitted to insurance providers, or doctors can securely share health records with relevant parties. It also substantiate how the Ethereum smart contracts will provide automated arbitrations in a secure environment by supporting real-time patient monitoring application. can be integrated with wearable Internet of Things (IoT) devices, revolutionizing health record monitoring for both patients and healthcare providers.

Blockchain technology Blockchain offers a secure and easily authenticated platform for data transfer from wearables like fitness trackers, health monitors, and activity devices. This

data is accessible to patients and doctors assuring a secure and real-time monitoring of the patients health and progress. Doctors can access this secured , regularly updated data which enable them to track patient's healthcare condition and make informed decisions about their healthcare. Insurance claims also plays a vital role in the healthcare field that can get benefits from block chain that provides transparency , immutability of stored data on it where in the blockchain medical insurance system that provides medical insurance industry with encrypted stored medical insurance data. The unique capabilities of blockchain which can help in real-time report of diseases and the that can help identify examination of disease patterns and its transmission parameters and origin.

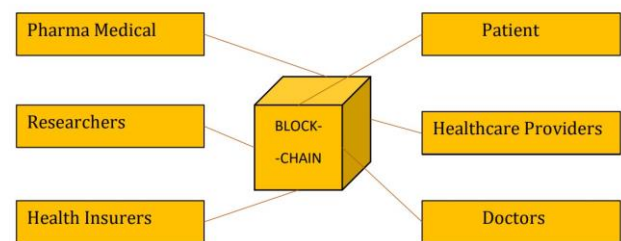


Figure 2 : Blockchain Streamlining Healthcare Roles

4.3 BLOCKCHAIN – E-GOVERNANCE

E-governance , often referred to electronic governance , is the usage of digital technologies to enhance and connect the government services to the citizens and engage the citizens in decision making . Initially E-governance is seen as the digitalization of the traditional government practices , making it more accessible and efficient .By implementing Blockchain in the field of e-governance we can upgrade the present practice and enhance the efficiency , transparency , and security to the operations and data .

1. Manage Digital identity: A decentralized Blockchain platform can be created for managing digital identities. These identities are verified and hash value of the identity is stored in the block, ensuring privacy and reducing the theft risks . This could facilitate secure across several services like online voting system .
2. Secure voting system: As the blockchain is immutable and tamper-resistant ,each vote is recorded as a tamper-proof transaction making it impossible to alter or manipulate which could lead to no fault tolerance .
3. Smart Contracts for Government services: Smart contracts , self executing agreements with predefined rules and conditions can be programmed to automate the government services. We can include the public or citizen pool to consider

the opinion of the people by using D-app (decentralized app)

4. Budget and expenditure transparency: By implementing the blockchain in government budget and expenditure, the public can track the funds usage which promotes transparency and accountability in government finance.
5. Digital Notary : Blockchain can be used as a digital notary by timestamping documents and transactions to verify its integrity and authenticity.
6. Governmnet pay: Blockchain can be used to track the distribution of the money, resources and other services to the people.

Benefits:

1. Transparency : Blockchain usage in E-governance improves the transparency by making the records transparent and available to the public and storing it in a immutable ledger ensuring all the data are visible to authorized people
2. Security: Blockchain encrypts the data by implementing cryptographic algorithms like SHA256 making it highly resistant to unauthorized access
3. Integrity: Data stored and recorded in blockchain cannot be deleted or altered.
4. Decentralization :By implementing blockchain we are removing the central authority, this reduces the risk of service/system failure as the nodes in network are up and running .
5. Efficiency: By using Smart contracts for self executing programs based on conditions or agreements we can reduce the human error and increase efficiency.13% of the Blockchain industry is considered to be E-governance.Several publications are being made inorder to implement blockchain in the government services

4.4 BLOCKCHAIN – SUPPLY CHAIN

A supply chain is a network formed by different organizations, people, activities, information and resources involved regarding moving a product/service from supplier to the customer and management of the product

Supply Chain management is necessary and used across several sectors including manufacturing, healthcare, logistics. In Traditional supply chain management, a person or an organization acts as a central authority and makes the decision and checks the status of the process or product. All the other members in the network are not provided with

accurate information and are dependent on the central authority. Stakeholders and customers does not get to know the status of the process/product accurately. Traditional supply chain management lacks transparency, limited Traceability, manually recording the data, Delay in Information, High management cost, Limited Trust.

Traditional supply chain follows linear structure where each participant performs its role in a sequential order by downstream. All the decisions are made by central authority such as product scheduling, replenishment which could lead to time delay. To overcome it, blockchain is implemented in supply chain management.

In Blockchain based supply chain management system, each step of the supply chain is recorded in blockchain, from raw materials extraction to end consumer, ensuring that every transaction and status is visible to the end consumer and immutable. This boosts the transparency in supply chain and reduces risk of fraud and counterfeiting. It provides consumers with the ability to trace the origin of products. In this system central authority is replaced by smart contracts and the process gets executed based on conditions, agreements which reduces the time delay in decision making. We can automate various processes like payment, order fulfillment, order status. Smart contracts streamline operations, reduces delays, and mitigate disputes. Data regarding the consumer and information of the products are stored by encrypting using blockchain's cryptographic techniques to ensure compliance with data privacy regulations.

5. CONCLUSION:

In the current era of technological advancement, blockchain has transformed with several real-world applications. Initially Blockchain is used in cryptocurrencies. Now blockchain has impact on various sectors by extending its advantages and acting as a transformative force for the real world operations. Decentralization and transparency plays a major role in implementing in real world applications. Blockchain offers enhanced security, traceability which is critical in several sectors. Blockchain is used in sectors like finance, supply chain, health care, E-governance and more.

Traditional banking system is replaced by the blockchain's decentralized finance and cryptocurrency offering secure and reducing intermediaries. Supply chain benefits from blockchain's usage by providing end-to-end visibility of the consumer. Blockchain being integrated in Healthcare industry to secure health records instead of traditional way of maintaining physical records. E-governance gets benefited by blockchains tamper-resistant immutable recording and integrity. In the new era, blockchain brings new ways of enhancing the real world applications by offering a new paradigm for industries.

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