Revolutionizing Library Services: The Role of Blockchain Technology in Effective Information Delivery

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Abstract- In the current digital landscape, libraries are adapting their conventional services to satisfy the rising demand for rapid, secure, and efficient information access. Blockchain technology has emerged as a formidable tool that can enhance transparency, security, and reliability within information systems. This research investigates the impact of blockchain technology on the transformation of library services and the improvement of information delivery. The paper explores the concepts of blockchain technology, examines its generations in library services, and the benefits it offers, including data security, digital rights management, and resource sharing. Additionally, it addresses the barriers and challenges that libraries may encounter when implementing blockchain technology. The study concludes that blockchain technology can significantly boost the efficiency and dependability of library services, thereby enhancing information management in modern libraries.

Keywords: Blockchain Technology, Library Services, Information Delivery, Digital Libraries, Information Management

I. INTRODUCTION

Blockchain is an emerging technology that will change the way we acquire and share information. A combination of technologies, including cryptography, peer-to-peer networks, smart contracts, and consensus mechanisms, to create a new kind of database. Currently, industry sectors such as finance, medicine, and government are making significant investments, investigating the transformational impact of blockchain.

Blockchain technology is a system that stores transaction records, also known as blocks, in multiple databases, known as the "chain," across a network of peer-to-peer nodes. Typically, this storage is referred to as a 'digital ledger.'

Blockchain is also considered a type of database, but it differs substantially from conventional databases in how it stores and manages information. Instead of storing data in rows, columns, tables, and files as traditional databases do, blockchain stores data in blocks that are digitally chained together. In addition, a blockchain is a decentralized database managed by computers belonging to a peer-to-peer network instead of a central computer, like in traditional databases. According to Conway (2020), blockchain is a type of database in which data or information is structured and filed in groups, also known as blocks, that hold sets of information, which are then chained to previously filed blocks, forming a chain of data/information known as blockchain.

II. REVIEW OF LITERATURE

Blockchain technology is often adopted in libraries in numerous ways, like for making an associate increased data system, protective digital initial sale rights, peer-to-peer sharing, and so on. This paper examines the application of blockchain technology in modern libraries. The researcher collected data for the study from online resources. (Mondal, 2021). blockchain technology verifies and stores transaction records. Researchers also briefly explain what the blockchain is and how it is being used presently, as well as some possible future uses that can help professionals in the fields of library and medicine as well. He also pointed out the negative side of blockchain, that is, technical complexity and environmental unsustainability (Hoy, 2017). This study shows the use of blockchain technologies in library services. The researcher found that blockchain technology is rapidly growing and evolving and that librarians need to understand its

benefits and risks, capabilities, and related aspects (Abid, 2021). blockchain technology should be created among librarians through in-house training, sponsorship to national and international conferences, seminars, or workshops. The author also suggested that university management should acquire and install adequate technological facilities required to utilize blockchain technology, such as internet connectivity, hardware, and other telecommunication facilities. (Obim, 2022). carried out a study on the amalgamation of Blockchain Technology with the Knowledge Management System and concluded that the Blockchain-based library would become the primary book management method for institutions or organizations in the future. The library management system would use blockchain-based record-keeping for the acquisition and circulation of books, fee or fine collection, and stock verification of library documents (Verma, 2021). University libraries are an important academic unit in higher education because it provides information in various formats to support the teaching, learning, and research objectives of the university. One of the major functions of university libraries, among many others, is to acquire, process, organize, disseminate, and preserve information resources in print or electronic format for users in a conducive environment. Over the years, university libraries have striven to embrace and apply emerging technology for effective service delivery, one of which is Blockchain technology (Onah, Adayi, Okonkwo, and Onyebuchi, 2020). stated that awareness of evolving technologies, such as blockchain technology, offers librarians the unique opportunity to facilitate partnership among libraries and their users, and to enhance user-centred services. Despite the relevance of awareness of emerging technology among librarians (Kushwaha and Singh, 2020).

III. OBJECTIVES OF THE STUDY

The major objectives of this study are:
1. To understand the concept of blockchain technology.
2. To examine the generations of blockchain technology in library services.
3. To identify the benefits of blockchain technology for effective information delivery.

4. To analyze the barriers and challenges associated with implementing blockchain technology in libraries.

IV. RESEARCH METHODOLOGY

This study is based on a descriptive and analytical research method. It involves the collection of secondary data from diverse sources, including research articles, books, journals, and online databases, all pertaining to blockchain technology and its application in library services. The data collected was analysed to understand the practical applications, benefits, and challenges of integrating blockchain technology within library systems.

Concept of Blockchain Technology
Blockchain operates as a decentralized database that maintains a continuously growing list of records called blocks. Each block contains a set of transactions and is linked to the previous block, forming a chain. This structure ensures that once information is recorded, it cannot be easily modified or deleted.
The primary characteristics of blockchain technology include decentralization, transparency, immutability, and security. These attributes make blockchain a dependable system for handling digital records and transactions.

Evolution and Trends in the Development and Use of Blockchain Technology
Blockchain serves as the secure backbone technology for Bitcoin, a digital currency introduced by Satoshi Nakamoto in 2008. Since its inception, Bitcoin has utilized blockchain to document all its transactions, which are systematically arranged into interconnected blocks. Each block contains a collection of transaction details pertinent to the Bitcoin network.

What is the Role of Blockchain Technology in Libraries?
Libraries stand to gain significantly from adopting blockchain technology, as it can enhance user privacy, foster greater collaboration, and revolutionize their engagement with communities. By remaining informed about technological trends, libraries can assess the potential of blockchain and strategically incorporate it into their practices.

Areas of Implementation of Blockchain Technology in Libraries

i. Interlibrary loan
ii. DRM
iii. Plagiarism
iv. Payments
v. User-to-user authentication
vi. Academic publishing

The Generations of blockchain Technology are outlined as follows:

1. 1st Generation: Blockchain 1.0The primary focus of the initial generation of blockchain technology was decentralized financial transactions and digital currency. It started with the creation of Bitcoin, which offered a transparent and safe way to record transactions via distributed ledgers. This generation established the groundwork for transparent data management and safe digital record-keeping in libraries. Without depending on a central authority, libraries can use blockchain-based systems to keep safe records of digital resources, transactions, and user activity.

2. 2nd Generation: Blockchain 2.0
The second generation broadened the scope of blockchain technology beyond just cryptocurrency by incorporating smart contracts, which are agreements that automatically execute and are stored within the blockchain network. Platforms like Ethereum facilitated secure and automated digital transactions. In the context of libraries, this technology can enhance automated licensing agreements for digital resources, streamline copyright management, and simplify interlibrary loan processes. Additionally, smart contracts can assist libraries in managing subscription access and digital rights more effectively.

3. 3rd Generation: Blockchain 3.0
The third generation uses blockchain in many areas, like education, healthcare, and information services. In libraries, decentralized applications (DApps) help manage digital collections, share information between institutions, and keep scholarly communication transparent. This generation allows for secure data sharing and long-term storage of digital collections.

4. 4th Generation: Blockchain 4.0
The fourth generation involves the fusion of blockchain with new technologies like Artificial Intelligence, the Internet of Things, and Cloud Computing. This combination can enhance digital resource management, user verification, and secure data storage in libraries. It also facilitates more sophisticated library services, including intelligent information retrieval, secure digital identity management for users, and effective collaboration between libraries and research institutions.

What is a block, and how does it work?
A block generally comprises three elements: Data, its own Hash, and the hash of the block before it. This structure ensures that each block in the chain contains both its unique cryptographic hash and that of the preceding block, thereby maintaining the chain's linkage.

Source: https://i.pinimg.com/originals/0c/6f/39/0c6f39236a984f8a47337eef9ebbd199.png
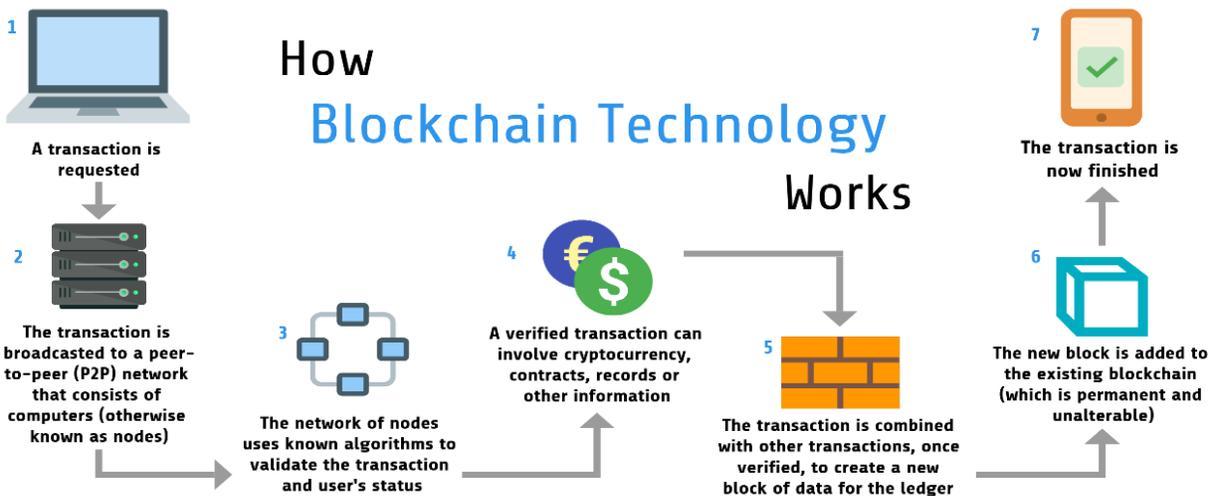
A Block is a primary unit of blockchain. In the blockchain, a block is a collection of data or information. The information is added to the block in the blockchain by connecting it with other blocks in chronological order and creating a chain of blocks linked together. Thus, it forms a chronological database of transactions that is shared with multiple nodes, i.e., computers or servers, in a network. The unique number added to a hashed or encrypted block, called Nonce that can be used only once, is selected by the miners to solve a cryptographic puzzle for generating the next block in the chain. It is known as Proof of Work. A Hash is a unique alphanumeric identifying code or number generated when any transaction happens in the blockchain. Hash is based on data of its own, a hash of the previous one, and its timestamp.

When a transaction happens in the blockchain, that transaction is recorded in a block, and that block must be validated before adding it to the chain. The authenticity of a block 5 must be verified through a consensus algorithm in which the majority of nodes (clients or servers) and the nodes having the highest stack in the chain of the distributed network must validate the block before adding it to the chain. After the validation of the block, a unique, identifying code, i.e., a hash, is generated. By doing this, we do not need any third-party interference to validate or to do transactions. Blocks can be recognized by their block number, block height, and block header hash. The data in the blocks is detected through a computerized algorithm known as the hash function. This function locks the data to be seen by the participants in the Blockchain and makes the data immutable. Every block has its own hash function. In Blockchain, the data is recorded permanently and cannot be changed. A small change in it generates a new block in the chain. Blockchain works like a digital notary with time stamps to avoid tampering with any information.

V.CHARACTERISTICS OF BLOCKCHAIN TECHNOLOGY IN LIBRARIES

1. Decentralisation: Decentralisation, in which data is held across several computers (nodes) rather than a single central server, is one of Blockchain's primary features. This enhances the dependability of digital records and services in libraries and decreases dependency on centralised systems.

2. Full transparency: Because every transaction is recorded in a shared ledger that participants can validate, blockchain technology offers transparent record-keeping. Transparency in libraries facilitates more precise tracking of digital resources, circulation records, and information transfers.

3. Unchangeability: Once recorded, data on a blockchain is difficult to change or remove. The validity and integrity of library documents, including digital archives, research data, and institutional repositories, are guaranteed by this immutability.

4. Safety: Blockchain uses techniques to secure data and stop illegal modifications. This enhances the security of user information, digital collections, and intellectual property for libraries.

5. Traceability: Blockchain makes it feasible to track the origin and movement of digital resources by recording each transaction in chronological order. This tool allows libraries to monitor interlibrary loan transactions, copyright ownership, and document usage.

VI.TYPES OF BLOCKCHAIN TECHNOLOGY

i. Public Blockchain: A public Blockchain network, also known as a permissionless Blockchain network, is completely open to anyone who wishes to join without needing any authorization. This is the primary and only difference between public and private Blockchain networks. In a permissionless network, anyone can participate, follow the consensus protocol, and help maintain the shared public ledger.

Advantages of Public Blockchain: More secure than a private network.

Drawbacks of Public Blockchain: Limited privacy, requires significant processing power and energy, less environmentally friendly.

ii. Private Blockchain: Joining a Private Blockchain Network requires an invitation. This invitation must be validated either by the network initiator or according to the rules set by the network initiator. A Permission Blockchain Network restricts participant entry and only allows the type of participants needed within the network.

Advantages of Private Blockchain: Increased privacy, more environmentally friendly, as it requires less processing power to achieve consensus.

Benefits of blockchain technology for effective information delivery

1. Enhanced Transparency and Traceability: Blockchain technology offers a transparent and permanent record of all transactions within the supply chain. This enhances product traceability, helps verify authenticity, and mitigates risks such as fraud and counterfeit goods.
2. Strengthened Security and Data Integrity: Using cryptography and decentralized networks, blockchain secures logistics data. This guarantees data integrity, prevents unauthorized access, and reduces the likelihood of cyberattacks or data manipulation.
3. Cost Reduction and Process Automation: Blockchain supports automation through smart contracts that automatically execute logistics agreements. This lowers administrative costs, decreases manual tasks, and enhances operational efficiency.
4. Improved Collaboration and Trust: A shared blockchain ledger provides all supply chain participants with access to consistent and reliable information. This fosters transparency, enhances coordination, and builds trust among suppliers, manufacturers, and logistics providers.
5. Faster Payment Processing: Blockchain can automate payment systems by employing smart contracts that release payments once delivery conditions are fulfilled. This speeds up transactions, improves cash flow, and reduces payment delays.
6. Sustainability and Ethical Sourcing: Blockchain facilitates transparent tracking of sourcing, production, and distribution processes. This encourages sustainable practices, ensures ethical sourcing of materials, and strengthens consumer trust in supply chain operations.

Barriers and challenges associated with implementing blockchain technology in libraries

1. Choosing the Right Blockchain
Blockchain does not serve as a one-size-fits-all solution for libraries, given the diversity of platforms and vendors available. Libraries face the choice of either developing their own systems or opting for services offered by technology providers. Furthermore, they must decide whether to use a private or public blockchain network. As pilot projects advance, libraries will acquire a more comprehensive understanding of how to effectively integrate blockchain technology.
2. Cost of Implementation
The adoption of new technology incurs both direct and indirect costs. Direct costs include expenses related to the acquisition, development, customization, and deployment of systems. Indirect costs can emerge from the need for staff training and the simultaneous operation of both old and new systems during the transition phase. Libraries must determine if the long-term benefits of the technology are worth these expenditures.
3. Cost of Maintenance and Development
Libraries that choose to integrate blockchain systems must consider the ongoing expenses related to maintenance and development. Although these costs might align with those of current systems, libraries could encounter challenges in hiring skilled professionals, as industry salaries tend to be higher.

VII.CONCLUSION

The integration of blockchain technology into library services has the potential to bring about significant changes by establishing a secure, transparent, and efficient system for managing information. Its application in areas such as digital rights management, secure record-keeping, resource sharing, and user authentication can greatly enhance the functionality of library operations. Although there may be obstacles in adopting blockchain technology within libraries, its long-term benefits make it a promising asset for the future of library and information services. Libraries that incorporate innovative technologies like blockchain will be better positioned to meet the evolving demands of users in the digital age.

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