Chapter 11
Engineering Applications of Blockchain in This Smart Era

Amit Kumar Tyagi
https://orcid.org/0000-0003-2657-8700
National Institute of Fashion Technology, New Delhi, India

Shabnam Kumari
SRM Institute of Science and Technology, Chennai, India

Chidambaram N.
Department of Professional Studies, Christ University, Bangalore, India

Avinash Sharma
Sharda University, Greater Noida, India

ABSTRACT

The advent of blockchain technology has revolutionized various industries, offering novel solutions to age-old problems. In this smart era, characterized by interconnected devices and burgeoning digital ecosystems, blockchain stands out as a transformative force. This chapter explores the emerging applications of blockchain technology in this paradigm shift towards smart systems. One prominent application of blockchain lies in the domain of decentralized finance (DeFi). Blockchain facilitates peer-to-peer transactions, eliminating the need for intermediaries like banks. Smart contracts, powered by blockchain, automate and execute agreements, enabling programmable finance, lending, and asset management. Moreover, blockchain's transparency and immutability enhance trust in financial transactions, fostering financial inclusion and security. In the realm of SCM, blockchain offers unprecedented transparency and traceability. By recording every transaction on an immutable ledger, blockchain enables users to track the journey of products from raw materials to end consumers.

1. INTRODUCTION TO BLOCKCHAIN TECHNOLOGY: KEY COMPONENTS, TYPES, FEATURES AND BENEFITS

Blockchain technology, originally introduced for Bitcoin, has rapidly evolved into a versatile and transformative tool with applications across various industries (Swan, 2015; Yli-Huumo et al., 2016). At its core, blockchain is a distributed ledger technology that enables secure, transparent, and decentralized recording of transactions and data. In this introduction, we'll discuss the key components, types, features, and benefits of blockchain technology. Here are few Key Components which can be discussed as:

DOI: 10.4018/979-8-3693-5261-8.ch011

Blocks: Blocks are the fundamental units of data in a blockchain. Each block contains a batch of transactions, along with a unique identifier called a cryptographic hash that links it to the previous block, forming a chronological chain of blocks.

Decentralized Network: Blockchain operates on a decentralized network of nodes, where each node maintains a copy of the entire blockchain ledger. This decentralized architecture ensures redundancy, fault tolerance, and resistance to censorship or tampering.

Consensus Mechanisms: Consensus mechanisms are protocols used to achieve agreement among network participants regarding the validity of transactions and the state of the ledger. Popular consensus mechanisms include Proof of Work (PoW), Proof of Stake (PoS), and Delegated Proof of Stake (DPoS).

Cryptographic Security: Blockchain relies on cryptographic techniques to secure transactions and data. Public-key cryptography enables users to generate unique digital signatures, proving ownership of assets and authorizing transactions. Hash functions ensure data integrity by generating fixed-size, unique identifiers for data stored on the blockchain.

Types of Blockchains

Public Blockchains: Public blockchains, such as Bitcoin and Ethereum, are open and permissionless networks where anyone can participate, transact, and validate transactions. These blockchains provide transparency, censorship resistance, and decentralization but may have scalability and privacy limitations.

Private Blockchains: Private blockchains are permissioned networks where access and participation are restricted to authorized entities. Private blockchains are often used within organizations or consortia to provide secure and efficient data sharing and collaboration.

Consortium Blockchains: Consortium blockchains are semi-decentralized networks controlled by a group of trusted entities or organizations. Consortium blockchains combine the benefits of public and private blockchains, providing scalability, privacy, and governance features tailored to the specific needs of the consortium members.

Features of Blockchain Technology

Transparency: Blockchain provides a transparent and immutable ledger of transactions, visible to all network participants. This transparency fosters trust and accountability by enabling real-time auditing and verification of transactions.

Security: Blockchain's decentralized architecture, cryptographic security, and consensus mechanisms ensure the integrity and security of transactions and data. Immutability and tamper resistance protect against fraud, manipulation, and unauthorized modifications.

Decentralization: Blockchain operates on a decentralized network of nodes, eliminating the need for central authorities or intermediaries to validate transactions. Decentralization enhances resilience, censorship resistance, and inclusivity in blockchain networks.

Efficiency: Blockchain enables automation of transactions and smart contracts, reducing manual processes, administrative overheads, and intermediation costs. This automation enhances efficiency, speed, and accuracy in transaction processing and contract execution.

Related Content

Segmentation of Spine Tumour Using K-Means and Active Contour and Feature Extraction Using GLCM
Malathi M., Sujatha Kesavanand Praveen K. (2023). *Research Anthology on Improving Medical Imaging Techniques for Analysis and Intervention (pp. 793-804).*
www.irma-international.org/chapter/segmentation-of-spine-tumour-using-k-means-and-active-contour-and-feature-extraction-using-glcm/315076

Deep Convolutional Neural Network-Based Analysis for Breast Cancer Histology Images
E. Sudheer Kumar, C. Shoba Binduand Sirivella Madhu (2023). *Research Anthology on Improving Medical Imaging Techniques for Analysis and Intervention (pp. 1267-1285).*
www.irma-international.org/chapter/deep-convolutional-neural-network-based-analysis-for-breast-cancer-histology-images/315103

Image Fusion Techniques for Different Multimodality Medical Images Based on Various Conventional and Hybrid Algorithms for Disease Analysis
Rajalingam B., Priya R., Bhavani R.and Santhoshkumar R. (2023). *Research Anthology on Improving Medical Imaging Techniques for Analysis and Intervention (pp. 268-299).*
www.irma-international.org/chapter/image-fusion-techniques-for-different-multimodality-medical-images-based-on-various-conventional-and-hybrid-algorithms-for-disease-analysis/315050

Biomedical Image Processing Software Development for Shoulder Arthroplasty
Majid Mohammad Sadeghi, Emin Faruk Kececi, Kerem Bilseland Ayse Aralasmak (2023). *Research Anthology on Improving Medical Imaging Techniques for Analysis and Intervention (pp. 756-773).*
www.irma-international.org/chapter/biomedical-image-processing-software-development-for-shoulder-arthroplasty/315074

Development of Algorithms for Medical Image Compression: Compression Algorithms
Pandian R. (2023). *Research Anthology on Improving Medical Imaging Techniques for Analysis and Intervention (pp. 126-141).*
www.irma-international.org/chapter/development-of-algorithms-for-medical-image-compression/315043