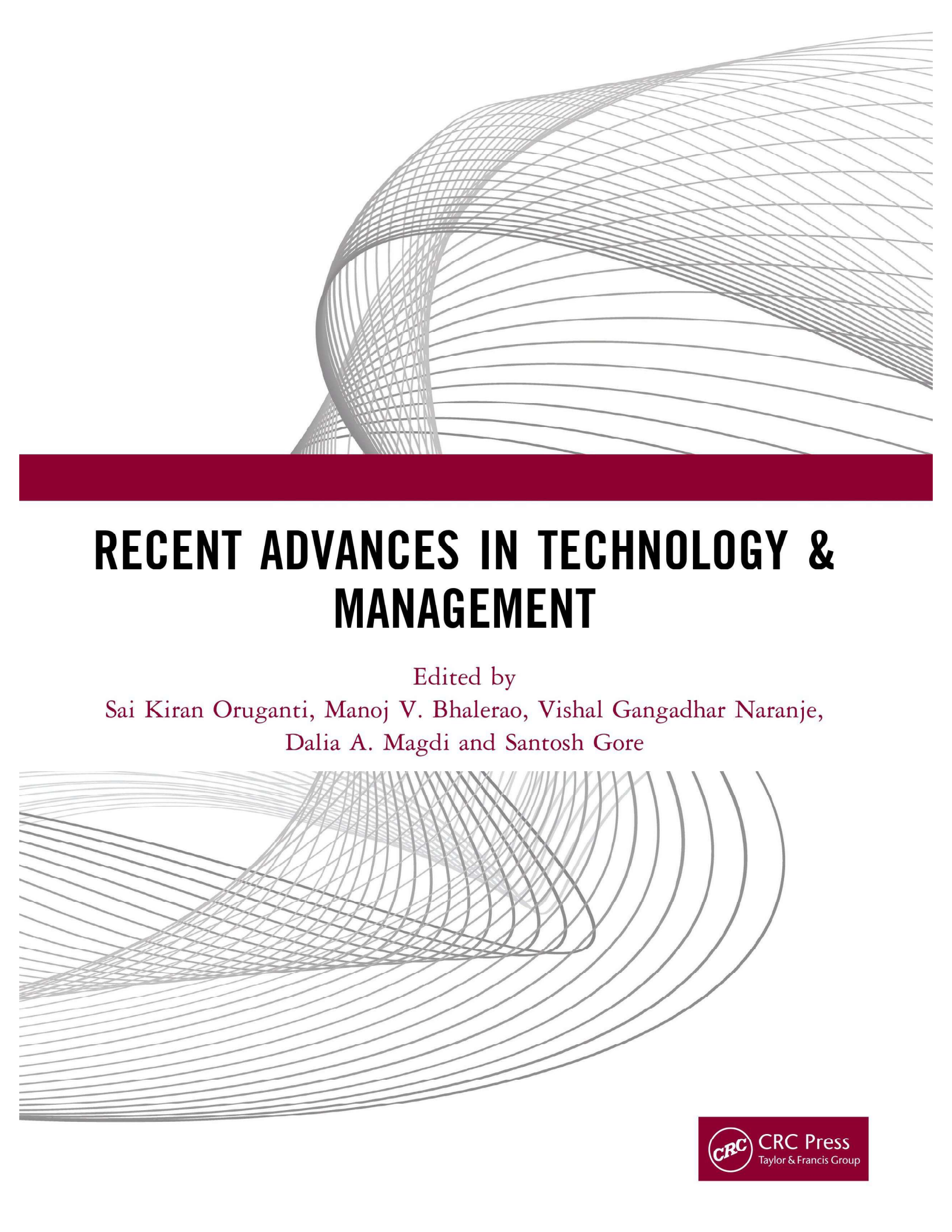




RECENT ADVANCES IN TECHNOLOGY & MANAGEMENT

Edited by

Sai Kiran Oruganti, Manoj V. Bhalerao, Vishal Gangadhar Naranje,
Dalia A. Magdi and Santosh Gore



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Recent Advances in Technology & Management

This volume presents a collection of innovative research contributions from scholars and professionals across diverse disciplines in science, engineering, and management. It offers a multidisciplinary perspective on emerging technologies and applied research, emphasizing the convergence of artificial intelligence, machine learning, Internet of Things (IoT), blockchain, cloud computing, computer vision, and sustainable engineering.

The collection explores cutting-edge developments and methodologies that address global and industrial challenges through intelligent systems, secure data infrastructures, automation frameworks, and sustainable practices. Each contribution provides original insights, conceptual advancements, and practical approaches that reflect the dynamic transformation of research and industry in the Industry 4.0 and smart technology era.

Designed for researchers, educators, and practitioners, the volume delivers both theoretical depth and applied relevance. It serves as a comprehensive reference for understanding how AI-enabled, data-driven, and sustainable innovations are reshaping the future of technology and management, fostering interdisciplinary learning and practical implementation across multiple domains.

Editor biographies:

Sai Kiran Oruganti

Prof. Dr. Sai Kiran Oruganti is with the School of Electrical and Automation Engineering, Jiangxi University of Science and Technology, Ganzhou, People's Republic of China, as a full Professor since October 2019. He is responsible for establishing an advanced wireless power transfer technology laboratory as a part of the international specialists team for the Center for Advanced Wireless Technologies. Between 2018-2019, he served as a senior researcher/Research Professor at Ulsan National Institute of Science and Technology. Previously, his PhD thesis at Ulsan National Institute of Science and Technology, South Korea, led to the launch of a university-incubated enterprise, for which he served as a Principal Engineer and Chief Designer in 2017-2018. After his PhD in 2016, he served Indian Institute of Technology, Tirupati in the capacity of Assistant Professor (Electrical Engineering) between 2016-2017. Prof. Dr. Oruganti, prime research focus is on the development of Wireless Power Transfer (WPT) for applications- Internet of Things (IoT) device charging, Agriculture, Electric Vehicle Charging, Biomedical device charging, Electromagnetically induced transparency techniques for military and defence applications, Secured shipping containers, and Nano Energy Generators. Prof. Dr. Oruganti has more than 21 patents pending on his credit, and several of those patent applications have passed the NoC stage. As of 2021, 16 of 21 patents have been granted. He is credited with the pioneering work in the field of Zenneck Waves-based Wireless Power Transfer systems. Most notably, he has been regarded as one of the few researchers in the field of WPT to be able to conduct power and signal transmission across partial Faraday shields. His recent paper, accepted by Nature Scientific Reports, has generated a lot of interest and excitement in the field. International Union of Radio Science (URSI) recognized his research efforts and awarded him the Young Scientist Award in 2016. He is also a recipient of the IEEE Sensors Council Letters of Appreciation.

Prof. Dr. Manoj V. Bhalerao

Prof. Dr. Manoj V. Bhalerao earned his Ph.D. in Electronics Engineering from Sathyabama University, Chennai, Tamil Nadu. He completed his M.E. in Electronics Engineering from Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, in 2008, and his B.E. in Electronics and Telecommunication Engineering from the University of Pune in 2003. His research focuses on Wireless Communication, particularly Visible Light Communication (VLC), with emphasis on high data-rate transmission, electromagnetic interference reduction, and effective bandwidth utilization. He is actively exploring the integration of VLC technology in domestic, industrial, and vehicular environments to enhance communication reliability and energy efficiency. His academic work reflects a strong commitment to advancing innovative, sustainable, and intelligent communication systems for next-generation network applications.

Dr. Vishal Gangadhar Naranje

Dr. Vishal Gangadhar Naranje is a distinguished educator and researcher with over 24 years of teaching and research experience. He earned his doctorate from S.V. National Institute of Technology, Surat, India, and is currently serving as an Associate Professor and Programme Leader for Mechanical Engineering at Amity University Dubai, UAE. In this role, he has been instrumental in enhancing the department's academic and research excellence. Dr. Naranje has an extensive research portfolio, with over 75 publications in esteemed international journals, conferences, and book chapters. His expertise spans additive manufacturing, sheet metal die design, digital manufacturing, and robotics. He has led sponsored research initiatives, securing grants from various research agencies and universities. Beyond academia, Dr. Naranje has

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Assoc. Prof. Dalia A. Magdi

Assoc. Prof. Dalia A. Magdi currently serves as the Vice Dean of the Computer Science School at the Canadian International College and Chair of ITAF (Internet of Things Application and Future International Conference). With over 28 years of experience in teaching Computer Sciences and Information Systems, she has held numerous prestigious positions, including Dean of the Faculty of Management and Information Systems at the French University in Egypt. Her extensive academic experience includes roles as coordinator for international programs at Université de Paris-Sud and the University of New Brunswick program at Sadat Academy for Management Sciences. She has taught at renowned institutions, including Ain Shams University, French University in Egypt, Arab Academy for Science and Technology, ESLSCA University, and Canadian International University. Prof. Magdi is highly active in research, serving as Vice-Director of CRI (Centre de Recherche Informatique) at the French University in Egypt. She is a distinguished member of multiple Editorial Boards and serves as a reviewer for numerous international journals, including SCIREA Journal of Information Science and the Internet of Things and Cloud Computing Journal. Her published works include the internationally recognized book “A Proposed Enhanced Model for Adaptive Multi-agent Negotiation Applied to E-commerce.”

Dr. Santosh I. Gore

Dr. Santosh I. Gore is the Founder and Director of Sai Info Solution, a global enterprise with operations spanning India, the UAE, the UK, Europe, and the USA. The organization specializes in academic research consultancy, technological innovation, and IT solutions, effectively bridging the gap between academia and industry. Under his visionary leadership, Sai Info Solution has redefined higher education across five continents for over 17 years, combining localized expertise with a strong international presence. Since its establishment in 2009, Dr. Gore has amassed extensive experience in research consultancy, university accreditation, international collaboration, and IT development. He has mentored numerous Ph.D. and Post-Doctoral researchers, guiding them in project design, publication strategy, and institutional partnerships with reputed journals and universities worldwide. His strategic insight has helped several institutions achieve academic excellence, global recognition, and sustainable growth. Under Dr. Gore's direction, Sai Info Solution has become a trusted global partner for universities and research organizations. The company provides end-to-end support for university establishment, NBA/NAAC/NIRF/ABET accreditation, QS and THE ranking strategies, international collaborations, IPR management, and research grant evaluation. Dr. Gore has collaborated with over 48 engineering, management, and polytechnic institutions across India and facilitated 32 Memorandums of Understanding with international journals. His initiatives have driven global conferences, institutional development programs, and academic collaborations, strengthening participation in NIRF, QS, and other international ranking frameworks. Through these efforts, Sai Info Solution has emerged as a leader in higher education transformation and global academic consulting. Dr. Gore's research interests encompass Artificial Intelligence, Machine Learning, Image Processing, Cybersecurity, Data Science, Wireless Communication Systems, and Neural Networks. He is proficient in C, C++, J2EE, MATLAB, Python, Swift, Dart, and PL/SQL, and operates seamlessly across Linux, macOS, and Windows Server platforms. He has authored or co-authored over 50 research papers in Scopus, Web of Science, and IEEE-indexed journals, earning 210+ citations, an h-index of 9, and an i10-index of 8. His recent work explores AI-driven wireless communication, deep learning for defect detection, cybersecurity in smart cities, healthcare AI, and blockchain-enabled IoT systems. Dr. Gore also holds multiple patents registered in India, the UK, the USA, and Germany, underscoring his commitment to innovation and technology-driven research. A recognized academic and technology expert, Dr. Gore has delivered keynote lectures, chaired sessions, and served as an invited speaker at numerous international conferences. He has conducted over 100 national and international workshops on topics such as ethical hacking, Android and Java development, .NET, NS2, and Linux. He serves as a reviewer and editorial board member for several reputed journals, including Computer Networks, Engineering Applications of Artificial Intelligence, Frontiers in Computer Science, Frontiers in Artificial Intelligence, Frontiers in Neuroscience, and IEEE Transactions on Cloud Computing. His review contributions span AI, Data Analytics, Networking, Cybersecurity, IoT, and related domains, extending to electronics, telecommunications, management, precision agriculture, supply chain management, and data mining. Through continued collaboration with academic leaders and policymakers, Dr. Gore champions innovation-driven education, high-quality research practices, and global knowledge exchange across the higher education ecosystem. Dr. Gore's outstanding achievements have earned him over 50 national and international awards, including the Maharashtra Business Icon Award (2023), recognition as a Technology Expert under DRDO's Technology Development Fund (TDF), and the Global Education Expert Award for Excellence in International Collaboration (2024). His accolades reflect his lasting contributions to research excellence, technological innovation, and academic leadership.

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Foreword

Technological innovation today stands at the intersection of intelligence, connectivity, and sustainability. The rapid evolution of artificial intelligence, machine learning, the Internet of Things, and blockchain technologies has redefined how industries operate, collaborate, and grow. Recent Advances in Technology & Management embodies this transformation by presenting a diverse collection of scholarly contributions that integrate scientific rigor with practical foresight.

This volume brings together interdisciplinary perspectives from researchers and professionals across the domains of science, engineering, and management. Each chapter contributes to a deeper understanding of how modern technologies, when aligned with sustainable and ethical principles, can drive strategic innovation and enhance decision-making across industries. The contributors have meticulously crafted a compendium that not only highlights theoretical advancements but also offers real-world insights into the implementation of intelligent and secure systems.

This book reflects the shared commitment of the academic and research community to advancing knowledge and fostering innovation in the era of Industry 4.0. It is our belief that this compilation will serve as a valuable reference for academicians, industry practitioners, and policymakers striving to harness emerging technologies for societal and organizational progress.

— The Editorial Board

Recent Advances in Technology & Management

Preface

It gives us great pleasure to present this edited volume, *Recent Advances in Technology & Management*. This book represents a collaborative effort to showcase innovative research contributions from scholars and practitioners working across diverse domains of science, engineering, and management. This volume intends to provide an integrated platform for sharing new ideas, frameworks, and methodologies that reflect the dynamic evolution of technology-driven systems and sustainable management practices.

The collection features a broad spectrum of topics encompassing artificial intelligence, machine learning, Internet of Things (IoT), blockchain, cloud computing, computer vision, and sustainable engineering. Each chapter has been carefully selected for its originality, relevance, and contribution to current technological and managerial discourse. Collectively, these works exemplify the interdisciplinary nature of modern research, where the convergence of emerging technologies fosters innovation, automation, and informed decision-making in the era of Industry 4.0.

The editors extend their sincere appreciation to all contributing authors for their scholarly dedication and to the reviewers whose constructive feedback helped refine each manuscript. Gratitude is also due to the supporting institutions and research communities that continue to encourage interdisciplinary exploration. We hope that this volume will serve as a valuable reference for researchers, academicians, and professionals seeking to understand and apply advanced technological and managerial concepts for sustainable progress.

— The Editorial Board
Recent Advances in Technology & Management

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The editors of Recent Advances in Technology & Management express their deepest gratitude to all individuals and institutions whose support made this volume possible.

We extend our heartfelt appreciation to Hon. Shri Rajendra V. Borhade, Chairman, Pune Vidyarthi Griha, for his visionary leadership and constant encouragement toward fostering academic excellence and research innovation. His unwavering commitment to education and institutional growth has been a guiding force behind this initiative.

Our sincere thanks are also due to Hon. Shri Sanjay N. Gunjal, Secretary, Pune Vidyarthi Griha, for his invaluable support, guidance, and continued motivation in promoting collaborative academic endeavors. His encouragement has been instrumental in realizing this publication.

We gratefully acknowledge the sustained cooperation of Pune Vidyarthi Griha's College of Engineering and Technology & G. K. Pate (Wani) Institute of Management, Pune, for providing a vibrant academic environment that nurtures innovation and scholarly exchange.

The editors also wish to thank all contributing authors and reviewers for their scholarly engagement and dedication, which have significantly enriched the quality and diversity of this volume. Special appreciation is extended to our supporting editors, advisory members, and institutional collaborators whose collective efforts have ensured the successful realization of this book.

Finally, we express our gratitude to the publishing team for their professionalism and to all readers and researchers who continue to inspire the pursuit of knowledge and innovation in science, engineering, and management.

— The Editorial Board

Recent Advances in Technology & Management

40 Privacy and security enhancement in WSNs with blockchain and deep learning

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Abstract

Wireless sensor networks (WSNs) offer cost-effective solutions for real-world challenges, but rapid advancements make security a critical concern. Blockchain technology offers a promising solution, particularly for securing wireless sensor networks. While past research has largely focused on homogeneous systems, our study emphasizes blockchain-based security in this domain. The Internet of Things (IoT) has had substantial advancements over more than a decade. It consists in combining smart gadgets in the systems of smart cities, learning, agriculture, and health. Many real-time monitoring applications rely on IoT. However, due to limited storage and evaluating power, smart devices were subjected to attacks, as traditional cryptographic methods are inadequate for ensuring robust security in these environments. The proposed method enhances WSN security using blockchain technology. By integrating blockchain (BC) with deep learning, particularly CNN-based feature extraction, the approach ensures secure data transfer. Built on an IoT-based wireless network, this model strengthens data transmission reliability through blockchain. Performance evaluation considers latency, throughput, packet delivery ratio, energy consumption, and communication overhead. Experimental results indicate that the fusion of deep learning and blockchain significantly bolsters data integrity, reducing vulnerabilities and ensuring robust WSN protection.

Keywords: Blockchain, deep learning, internet-of-things, security, wireless sensor networks

Introduction

Wireless sensor networks allow data transfer through sensor nodes (SN) that will sense and transmit data in the network. Very much energy is consumed during power consumption and dissipation for transmitting data in the network [1]. They are extensively classified in fields like battlefield surveillance, disaster management, health care, etc. [2, 3]. These applications often face security risks due to WSNs' wireless nature and deployment in unsecured locations. Internet of Things (IoT) is a fast-moving field in modern technology, finding uses in healthcare, accident prevention, tracking, home automation, and industrial emergency management [4, 5]. Combining blockchain technology with IoT devices ensures added security by providing a decentralized, tamper-proof environment in which data security and trust are guaranteed [6–10].

Key Contributions

This provides a wireless sensor network security solution that exploits the integration of blockchain technology with convolutional neural networks for intelligent feature learning. The proposed model improves data transmission reliability and strengthens cyber defenses through blockchain's decentralized security features. Efficiency comparison results demonstrate the model's superiority against standard algorithms such as AODV, LEACH, AES, and ECC.

This work is divided into five different sections Section 2 features related studies. Section 3 then explores suggested methodology and Section 4 presents results, discussion, and the actual application of the suggested methods. Finally, Section 5 concludes entire work by outlining the next steps.

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Literature Review

The survey investigates BWSN architecture, applications, and security contributions, such as smart contracts, data management, and security improvements. Fukushima et al. [13] proposed a balancing UE distribution that involves modifying connection parameters based on user transitions and current UE count. As stated by Lee and Lee [2], a fresh perspective is introduced in the domain of WSN regarding data transmission involving blockchain and cross-layer concept (CLC). In their work, Swamy et al. [12] reviewed blockchain for secure data transmission in WSN, proposing architecture to improve privacy and security. Maheswari and Kalaiselvi introduced medical image chain, a platform that synergizes blockchain with convolutional neural network (CNN) for secure handling of medical images [11]. Nonetheless, the given studies have some limitations in their analyses. These limitations reinforce the need for further work to fill the gaps and make an informed decision on the integration between deep-learning methodologies and hybridization of consensus algorithms.

Materials and Methods

This study presents a new security framework for WSNs that integrates blockchain technology with CNNs for intelligent feature acquisition. The idea involves putting together all the data corresponding to various nodes, collected by IoT sensors, centrally. CNNs will later be used in the feature extraction process after preprocessing cleans and normalizes the data. The whole workflow is supervised by blockchain, ensuring that integrity is maintained at all levels of the process and that the data is secure. Proposed wireless sensor network with blockchain approach shown in Figure 40.1. The input layer in the CNN models receives inputs of a certain size only. To work image metadata, multiple stacks with layers containing convolution, pooling, ReLu, drop, and normalization operations are connected to input. Corresponding mathematical formula Eq (1) for the same is given below:

$$F(i, j) = \sigma(\sum_m \sum_n K(m, n)I(i + m, j + n) + b) \quad (1)$$

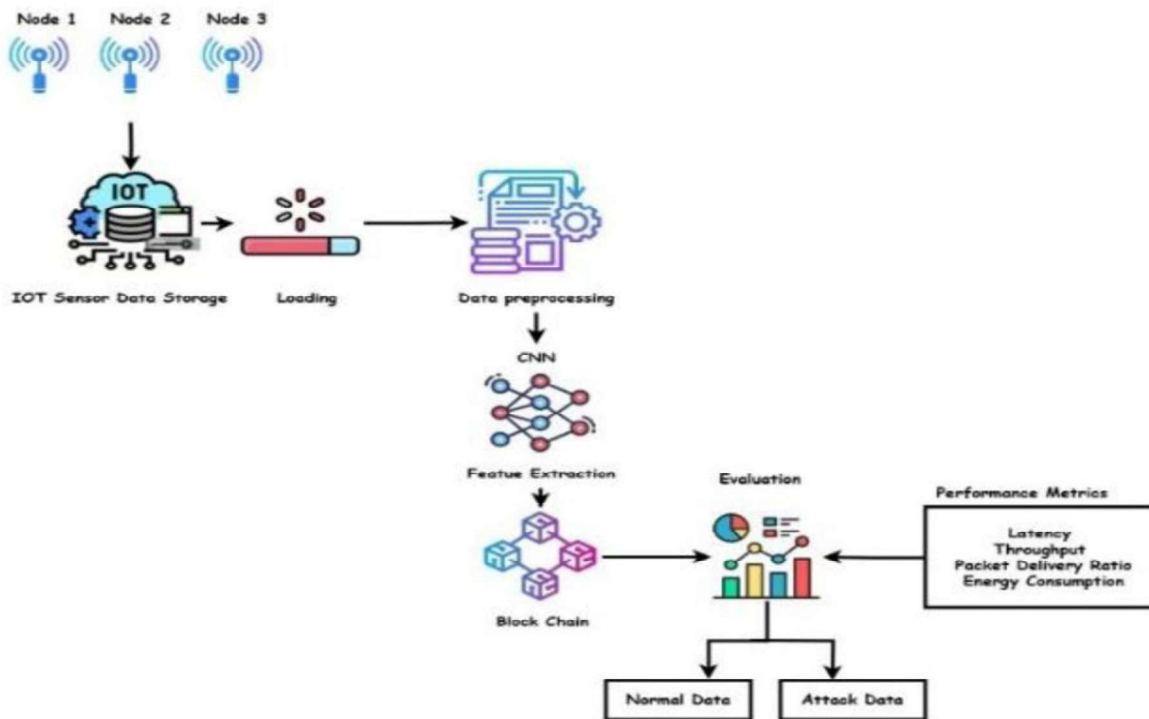


Figure 40.1 Proposed wireless sensor network with blockchain approach

Source: Author

In CNN, the last feature maps are usually subjected to pooling and then connected with fully connected layers for classification. This structure helps improve performance without compromising on strength.

Blockchain

Connecting sensor nodes in a decentralized blockchain-enabled WSN is done by security provisions such as hashing, secret keys, and cryptography. Node from storage- authenticating sensor data and linking all blocks through their hash function. Invalid connections, on the one hand, violate linking and stop data transmission, thus safeguarding the network's integrity.

Comparison with State-of-the-Art Systems

The latency results of the proposed blockchain approach in comparison to LEACH, AODV, AES, and ECC are given in Figure 40.2. This proposed technique has decreased latency, which is attributed to its energy-efficient paradigm.

Proposed scheme as depicted in Figure 40.3 consumed less energy on account of its efficient energy model, reducing the total consumption of energy across the network.

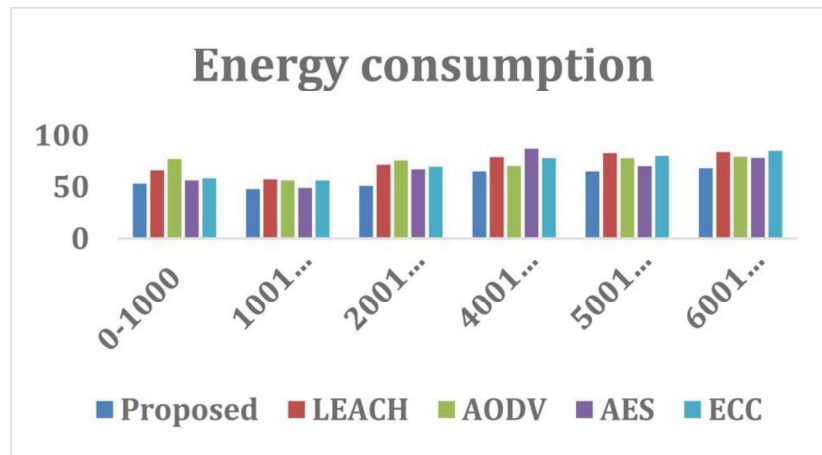


Figure 40.2 Latency rate

Source: Author

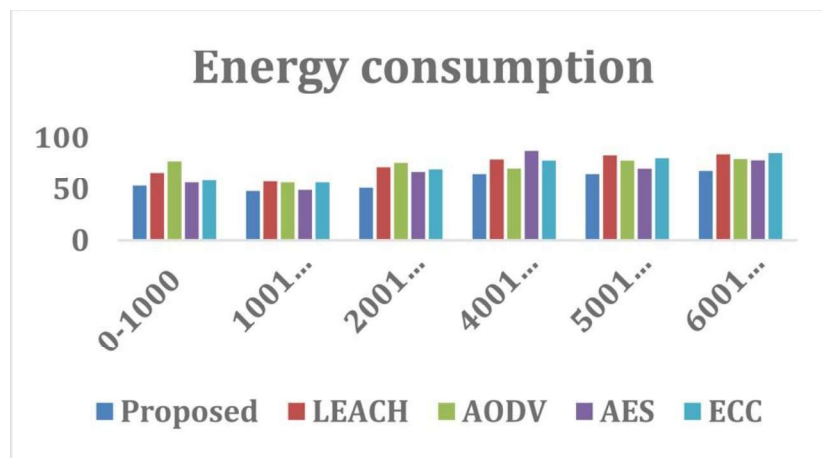


Figure 40.3 Energy consumption

Source: Author

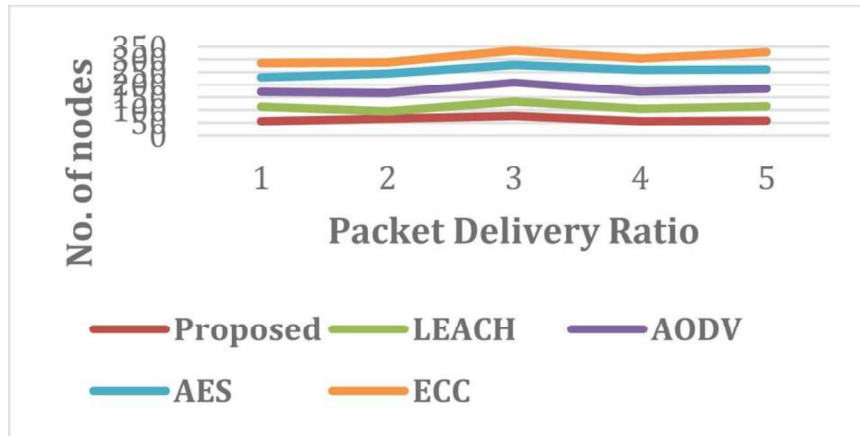


Figure 40.4 Packet delivery ratio

Source: Author

Figure 40.4 suggests that the proposed methodology has improved delivery because of energy efficiency resulting in better packet transmission and reliability of the network compared to other methods.

Conclusion and Further Work

Problem statement addressed/motivation: Boosting privacy and security in WSNs through blockchain and deep learning that provides tamperproof data exchanges and anomaly detection. Method used: Blockchain integration for secure data exchanged along with CNNs for feature extraction in anomaly detection. Key findings: Clear latency reduction increased packet delivery ratio (PDR) ratio as well as optimal energy consumption, rendering the model suitable for real time applications. Limitations and future work: The possibility of further energy optimization is through addition of lightweight cryptographic primitives for the security improvement in lesser resources.

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