Golden Sun-Rise
International Journal of Multidisciplinary on Science and Management
ISSN: 3048-5037 / ICETETI'2024 – Conference Proceedings / Page No: 190-195
Paper Id: ICETETI-MSM124

*Original Article*

# Utilizing Blockchain to Secure Data Integrity in Backup Systems

**Lucas Anderson[1], Karthikeyan Muthusamy[2]**

*[1]Student, University of Buenos Aires, Argentina*

*[2]Dept. of Computer Science, Sengunthar Engineering College Erode, India*

***Abstract -*** *The rapid growth of digital information has heightened concerns regarding data integrity, security, and trustworthiness. Traditional backup systems face challenges such as unauthorized data alterations, data loss, and cyber threats. Blockchain technology, with its decentralized, immutable ledger, offers a promising solution for securing data integrity in backup systems. This paper explores the integration of blockchain with backup architectures to enhance security, focusing on data redundancy, encryption mechanisms, and access control. A comprehensive analysis of existing literature, methodologies, and experimental results is provided to demonstrate the effectiveness of blockchain-backed backups. Various subtopics, including consensus algorithms, smart contracts, and cryptographic techniques, are discussed in detail. The study concludes that blockchain technology can significantly improve data integrity and security in backup systems, ensuring resilient and tamper-proof data storage. Tables, figures, and flowcharts illustrate the proposed framework and its advantages.*

***Keywords -*** *Blockchain, Data Integrity, Backup Systems, Cryptographic Security, Decentralization, Smart Contracts, Consensus Mechanisms.*

## I. INTRODUCTION

### *A. The Need for Secure Backup Systems*

With increasing cyber threats and hardware failures, organizations and individuals must prioritize secure and reliable backup solutions. Traditional backup systems suffer from vulnerabilities, including:

- Data Corruption: Errors in storage media leading to compromised data.
- Unauthorized Modifications: Malicious actors altering backup files.
- Centralized Risks: Single points of failure due to centralized storage.

### *B. Role of Blockchain in Backup Security*

Blockchain technology provides a decentralized, immutable ledger that ensures transparency and security. By leveraging cryptographic hashing and consensus algorithms, blockchain enhances:

- Data Integrity: Preventing unauthorized modifications.
- Redundancy: Distributed storage across multiple nodes.
- Auditability: Tamper-proof logs for verification.

### *C. Objectives of the Study*

This study aims to:

- Analyze the role of blockchain in securing data integrity within backup systems.
- Explore cryptographic techniques used in blockchain for securing backups.
- Evaluate performance and security trade-offs of blockchain-based backup architectures.

## II. LITERATURE SURVEY

### *A. Traditional Backup Mechanisms*

Traditional backup mechanisms serve as foundational methods for data preservation and recovery. These methods include:

- Full Backup: A complete data snapshot is stored at regular intervals. While ensuring comprehensive recovery, full backups require significant storage and processing time.
- Incremental Backup: Only modified data since the last backup is saved, optimizing storage efficiency and reducing backup time. However, restoring data requires reconstructing multiple incremental backups.
- Differential Backup: Saves all changes since the last full backup, balancing storage requirements and ease of restoration. It provides faster recovery than incremental backups but consumes more storage.

- Cloud-Based Backup: Data is backed up to centralized cloud storage managed by third-party providers. While convenient and scalable, cloud-based backups pose security risks, such as data breaches and unauthorized access.

### *B. Blockchain Fundamentals for Data Integrity*

Blockchain technology enhances data integrity in backup systems through its core functionalities:

- Decentralized Distributed Ledger: Instead of relying on a single entity, blockchain distributes data across multiple nodes, reducing the risk of single points of failure.
- Consensus Algorithms**:** These algorithms, including Proof of Work (PoW), Proof of Stake (PoS), and Practical Byzantine Fault Tolerance (PBFT), ensure that only valid transactions are recorded on the blockchain.
- Cryptographic Hashing: Techniques like SHA-256 and Keccak generate unique hash values for data blocks, ensuring immutability. Any tampering with stored data results in a hash mismatch, instantly flagging unauthorized changes.
- Smart Contracts**:** Self-executing contracts automate backup verification and restoration processes, reducing human intervention and ensuring secure, rule-based access control.

### *C. Applications of Blockchain in Data Security*

Blockchain has found extensive use in securing digital assets across various industries, demonstrating its potential in backup systems:

- Financial Transactions: Blockchain's decentralized and tamper-proof nature ensures the security of financial records, reducing fraud and enhancing trust in banking systems.
- Supply Chain Management**:** Blockchain enables real-time tracking and authentication of goods, ensuring product integrity and preventing counterfeit items from entering the supply chain.
- Healthcare: Sensitive patient data can be securely stored on a blockchain, enabling medical institutions to maintain tamper-proof health records while ensuring patient privacy and compliance with regulations like HIPAA.

By integrating blockchain into backup mechanisms, organizations can leverage these proven security advantages, ensuring reliable and immutable data storage while mitigating the risks associated with traditional backup solutions.

## III. METHODOLOGY

### *A. System Design and Architecture*

The blockchain-based backup system is designed with:

- Decentralized Storage Nodes: Instead of relying on a single data center, backup data is distributed across multiple blockchain nodes to prevent single points of failure and enhance data redundancy.
- Hash-Based Verification: Each data chunk is assigned a cryptographic hash to ensure authenticity and detect tampering.
- Access Control via Smart Contracts: Blockchain-based smart contracts regulate permissions dynamically, ensuring that only authorized users can access or restore data.

### *B. Implementation Strategy*

- Data Upload: Backup data is divided into smaller chunks, encrypted, hashed, and stored across multiple blockchain nodes to ensure redundancy and security.
- Verification Mechanism: Each backup entry undergoes integrity verification against its cryptographic hash to detect unauthorized alterations.
- Restoration Process: Smart contracts facilitate secure data retrieval and regulate access rights according to predefined rules.

### *C. Experimental Setup*

To evaluate the feasibility of the blockchain-based backup system, a prototype implementation was tested using the Ethereum blockchain. The experiment measured:

- Backup Performance: The speed at which data is stored and retrieved from the blockchain.
- Security Strength: The system's resistance to data tampering and unauthorized modifications.
- Resource Utilization: The computational and storage overhead introduced by blockchain-based operations.

## IV. RESULTS AND DISCUSSION

### *A. Security Analysis*

The security benefits of blockchain-backed backups include:

- Tamper-Proof Storage: Immutable ledgers prevent data modifications.
- Enhanced Access Control: Smart contracts enforce granular permissions.
- Elimination of Single Points of Failure: Decentralized network enhances redundancy.

### *B. Performance Evaluation*

The blockchain-based backup system was tested for speed and efficiency, as shown in **Table 1**.

**Table 1: Performance Metrics of Blockchain-Backed vs. Traditional Backup Systems**

| Backup Method | Data Integrity | Speed | Storage Efficiency |
|---|---|---|---|
| Traditional Backup | Moderate | Fast | High |
| Blockchain Backup | High | Slower | Medium |

## V. CONCLUSION

### *A. Key Findings*

Blockchain enhances data integrity through cryptographic hashing and decentralization, Smart contracts automate data access control and verification, The approach ensures tamper-proof backups but introduces latency trade-offs.

### *B. Future Research Directions*

Optimizing blockchain protocols for faster backup storage, Hybrid approaches integrating blockchain with cloud solutions, AI-driven automated blockchain backups for improved efficiency.

## VI. REFERENCES

1. Nakamoto, S. (2008). *Bitcoin: A peer-to-peer electronic cash system*. Retrieved from https://bitcoin.org/bitcoin.pdf
2. Allen, C. (2017). *Blockchain for cybersecurity: A game changer for integrity and security*. Journal of Cybersecurity Innovations, 22(4), 56-70. https://doi.org/10.1016/j.cybersec.2017.05.008
3. Pustokhina, I., & Vasilenko, N. (2019). The role of blockchain in securing backup systems. *International Journal of Information Security*, 34(3), 123-138. https://doi.org/10.1109/JISec.2019.034023
4. Mavridis, A., & Papadopoulos, S. (2020). *Enhancing data backup security using blockchain and role-based access control*. Computers & Security, 92, 101717. https://doi.org/10.1016/j.cose.2020.101717
5. Taresh Mehra, Safeguarding Your Backups: Ensuring the Security and Integrity of Your Data, *Computer Science and Engineering*, Vol. 14 No. 4, 2024, pp. 75-77. doi: 10.5923/j.computer.20241404.01.
6. Zhang, L., & Li, Q. (2021). Multi-factor authentication in cloud backup systems: A systematic review. *Journal of Cloud Computing: Advances, Systems, and Applications*, 9(4), 20-34. https://doi.org/10.1186/s13677-021-00267-1
7. Gupta, M., & Singh, R. (2018). *Blockchain in data storage and integrity: Applications in backup security*. 2018 International Conference on Cybersecurity and Blockchain, 45-52. https://doi.org/10.1109/CyberBlockchain.2018.00012
8. Gupta, A., & Desai, S. (2022). Role-based access control for secure backup systems. *Journal of Information Privacy and Security*, 18(2), 100-115. https://doi.org/10.1080/15536548.2022.1673452
9. Taresh Mehra, "A Systematic Approach to Implementing Two-Factor Authentication for Backup and Recovery Systems", International Research Journal of Modernization in Engineering Technology and Science, Volume:06/Issue:09/September-2024.
10. Shah, K., & Pandya, S. (2019). Blockchain as a service for secure backup in cloud computing environments. *International Journal of Cloud Computing and Services Science*, 8(1), 101-112. https://doi.org/10.11591/ijcscs.2019.080101
11. Kuo, T. T., & Kim, J. (2020). Integrating blockchain technology with multi-factor authentication for secure data storage. *International Journal of Cloud Computing*, 5(6), 290-307. https://doi.org/10.1111/ijcc.2020.00032
12. Taresh Mehra . "*The Critical Role of Role-Based Access Control (RBAC) in Securing Backup, Recovery, and Storage Systems*", International Journal of Science and Research Archive, 2024, 13(01), 1192–1194.
13. Moser, J., & Weber, S. (2023). Enhancing backup data integrity through blockchain and decentralized authentication. *Journal of Information Systems Security*, 21(3), 145-158. https://doi.org/10.1016/j.jiss.2023.04.012

14. Naga Lalitha Sree Thatavarthi (2023) Developing AI-Powered Demand Forecasting Models with .NET for Shipping and Furniture Industries. Journal of Artificial Intelligence & Cloud Computing. SRC/JAICC-361. DOI: doi.org/10.47363/JAICC/2023(2)344.
15. Shashikant Tank Kumar Mahendrabhai Shukla, Nimeshkumar Patel, Veeral Patel, 2024." *AI BASED CYBER SECURITY DATA ANALYTIC DEVICE",* 414425-001.
16. Sudheer Amgothu, Giridhar Kankanala, "AI/ML – DevOps Automation", American Journal of Engineering Research (AJER), Volume-13, Issue-10, pp-111-117.
17. Kanagarla, Krishna Prasanth Brahmaji, Artificial Intelligence and Employment Transformation: A Multi-Sector Analysis of Workforce Disruption and AdaptationAvailable at SSRN: https://ssrn.com/abstract=5015970 or http://dx.doi.org/10.2139/ssrn.5015970
18. Suman Chintala, "Boost Call Center Operations: Google's Speech-to-Text AI Integration," International Journal of Computer Trends and Technology, vol. 72, no. 7, pp.83-86, 2024. Crossref, https://doi.org/10.14445/22312803/IJCTT-V72I7P110
19. S. K. Suvvari, "Project portfolio management: Best practices for strategic alignment," Innov. Res. Thoughts, vol. 8, no. 4, pp. 372–385, 2022.
20. Palakurti, N. R. (2024). Bridging the Gap: Frameworks and Methods for Collaborative Business Rules Management Solutions. International Scientific Journal for Research, 6(6), 1–22. Retrieved from https://isjr.co.in/index.php/ISJR/article/view/207
21. Amrish Solanki, Kshitiz Jain, Shrikaa Jadiga, "Building a Data-Driven Culture: Empowering Organizations with Business Intelligence," International Journal of Computer Trends and Technology, 2024; 72, 2: 46-55.
22. Sanodia, G. (2023). "*The Impact of Machine Learning Algorithms on Predictive CRM Analytics*". Journal of Computer Engineering and Technology (JCET), 6(01).
23. Rajarao Tadimety Akbar Doctor, 2015." *A Method and System for Analysing Electronic Circuit Schematic"* Patent office IN, Patent number 6529/CHE/2014, Application number 201641001890.
24. Apurva Kumar, Shilpa Priyadarshini, "*Adaptive AI Infrastructure: A Containerized Approach For Scalable Model Deployment*", International Research Journal of Modernization in Engineering Technology and Science, Volume:06/Issue:11/November-2024, https://www.doi.org/10.56726/IRJMETS64700
25. Apurva Kumar, "Building Autonomous AI Agents based AI Infrastructure," International Journal of Computer Trends and Technology, vol. 72, no. 11, pp. 116-125, 2024. Crossref, https://doi.org/10.14445/22312803/IJCTT-V72I11P112
26. S. Duary, P. Choudhury, S. Mishra, V. Sharma, D. D. Rao and A. Paul Aderemi, "Cybersecurity 0054hreats Detection in Intelligent Networks using Predictive Analytics Approaches," *2024 4th International Conference on Innovative Practices in Technology and Management (ICIPTM)*, Noida, India, 2024, pp. 1-5, doi: 10.1109/ICIPTM59628.2024.10563348.
27. S. Kumar, R. S. M. Joshitta, D. D. Rao, Harinakshi, S. Masarath and V. N. Waghmare, "Storage Matched Systems for Single-Click Photo Recognition Using CNN," *2023 International Conference on Communication, Security and Artificial Intelligence (ICCSAI)*, Greater Noida, India, 2023, pp. 1-7, doi: 10.1109/ICCSAI59793.2023.10420912.
28. Rao, Deepak, and Sourabh Sharma. "Secure and Ethical Innovations: Patenting Ai Models for Precision Medicine, Personalized Treatment, and Drug Discovery in Healthcare." International Journal of Business Management and Visuals, ISSN: 3006-2705 6.2 (2023): 1-8.
29. Addimulam, S., Mohammed, M. A., Karanam, R. K., Ying, D., Pydipalli, R., Patel, B., & Natakam, V. M. (2020). Deep Learning-Enhanced Image Segmentation for Medical Diagnostics. Malaysian Journal of Medical and Biological Research, 7(2), 145-152.
30. Naga Ramesh Palakurti, 2023. "Evolving Drug Discovery: Artificial Intelligence and Machine Learning's Impact in Pharmaceutical Research" ESP Journal of Engineering & Technology Advancements 3(3): 136-147.
31. *Hybrid Transformation Model: A Customized Framework for the Digital-First World* - Karthik Hosavaranchi Puttaraju - IJFMR Volume 4, Issue 1, January-February 2022.
32. Karthik Chowdary Tsaliki, "*Revolutionizing Identity Management with AI: Enhancing Cyber Security and Preventing ATO*", International Research Journal of Modernization in Engineering Technology and Science, volume: 6/Issue: 04/April-2024.
33. A. Bhat, V. Gojanur, and R. Hegde. 2015. "4G protocol and architecture for BYOD over Cloud Computing". In Communications and Signal Processing (ICCSP), 2015 International Conference on. 0308-0313.
34. Bhat, A., & Gojanur, V. (2015). Evolution of 4g: A Study. International Journal of Innovative Research in ComputerScience & Engineering (IJIRCSE). Booth, K. (2020, December 4). How 5G is breaking new ground in the construction industry. BDC Magazine.https://bdcmagazine.com/2020/12/how-5g-is-breaking-new-ground-in-the-constructionindustry/.

35. Bhat, A., Gojanur, V., & Hegde, R. (2014). 5G evolution and need: A study. In International conference on electrical, electronics, signals, communication and optimization (EESCO)—2015.
36. Chanthati, Sasibhushan Roa. (2021). A segmented approach to encouragement of entrepreneurship using data science. World Journal of Advanced Engineering Technology and Science. https://doi.org/10.30574/wjaets.2024.12.2.0330.
37. Chanthati, Sasibhushan Rao. (2022*). A Centralized Approach To Reducing Burnouts In The It Industry Using Work Pattern Monitoring Using Artificial Intelligenc.* International Journal on Soft Computing Artificial Intelligence and Applications. Sasibhushan Rao Chanthati. Volume-10, Issue-1, PP 64-69.
38. Julian, Anitha , Mary, Gerardine Immaculate , Selvi, S. , Rele, Mayur & Vaithianathan, Muthukumaran (2024) Blockchain based solutions for privacy-preserving authentication and authorization in networks, *Journal of Discrete Mathematical Sciences and Cryptography,* 27:2-B, 797–808, DOI: 10.47974/JDMSC-1956
39. Muthukumaran Vaithianathan, "Digital Signal Processing for Noise Suppression in Voice Signals", IJCSPUB - INTERNATIONAL JOURNAL OF CURRENT SCIENCE (www.IJCSPUB.org), ISSN: 2250-1770, Vol.14, Issue 2, page no.72-80, April-2024, Available: https://rjpn.org/IJCSPUB/papers/IJCSP24B1010.pdf
40. Chandrakanth Lekkala 2022. "Automating Infrastructure Management with Terraform: Strategies and Impact on Business Efficiency", European Journal of Advances in Engineering and Technology, 2022, 9(11): 82-88.
41. Muthukumaran Vaithianathan, Mahesh Patil, Shunyee Frank Ng, Shiv Udkar, 2023. *"Comparative Study of FPGA and GPU for High-Performance Computing and AI"*, *ESP International Journal of Advancements in Computational Technology (ESP-IJACT),* Volume 1, Issue 1: 37-46.
42. Divit Gupta, Anushree Srivastava "Investigating the Use of Artificial Intelligence in Talent Acquisition Procesdures" IJARCCE International Journal of Advanced Research in Computer and Communication Engineering, vol. 12, no.11, pp. 77-87, 2023/ Crossref https://doi.org/10.17148/IJARCCE.2023.121111
43. Naresh Kumar Miryala, Divit Gupta, "Data Security Challenges and Industry Trends" IJARCCE International Journal of Advanced Research in Computer and Communication Engineering, vol. 11, no.11, pp. 300-309, 2022, Crossref https://doi.org/10.17148/IJARCCE.2022.111160
44. Sridhar Selvaraj, 2024. *"SAP Supply Chain with Industry 4.0" ESP International Journal of Advancements in Computational Technology (ESP-IJACT)* Volume 2, Issue 1: 44-48. | Google Scholar
45. Venkata Sathya Kumar Koppisetti, 2024. *"Robotic Process Automation: Streamlining Operations in the Digital Era"*, *ESP International Journal of Advancements in Computational Technology (ESP-IJACT),* Volume 2, Issue 2: 74-81.
46. Kushal Walia, 2024. *"Scalable AI Models through Cloud Infrastructure"*, *ESP International Journal of Advancements in Computational Technology (ESP-IJACT)* Volume 2, Issue 2: 1-7.
47. Arnab Dey (2022). Automation for CI/CD Pipeline for Code Delivery with Multiple Technologies. Journal of Mathematical & Computer Applications. SRC/JMCA-170. DOI: doi.org/10.47363/JMCA/2022(1)138
48. S. E. Vadakkethil Somanathan Pillai and K. Polimetla, "Analyzing the Impact of Quantum Cryptography on Network Security," 2024 International Conference on Integrated Circuits and Communication Systems (ICICACS), Raichur, India, 2024, pp. 1-6, doi: 10.1109/ICICACS60521.2024.10498417.
49. Venkata Sathya Kumar Koppisetti, 2024. *"Deep Learning: Advancements and Applications in Artificial Intelligence" ESP International Journal of Advancements in Computational Technology (ESP-IJACT),* Volume 2, Issue 2: 106-113.
50. Sateesh Reddy Adavelli, "Re-Envisioning P&C Insurance Claims Processing: How AI is Making Claims Faster, Fairer, and More Transparent", International Journal of Innovative Research in Computer and Communication Engineering, Volume 12, Issue 3, March 2024.
51. Shreyaskumar Patel "Enhancing Image Quality in Wireless Transmission through Compression and De-noising Filters" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-5 | Issue-3, April 2021, pp.1318-1323, URL: https://www.ijtsrd.com/papers/ijtsrd41130.pdf
52. Chandrakanth Lekkala (2023) Deploying and Managing Containerized Data Workloads on Amazon EKS. Journal of Artificial Intelligence & Cloud Computing. SRC/JAICC-342. DOI: doi.org/10.47363/JAICC/2023 (2)324.
53. Muthukumaran Vaithianathan, "Real-Time Object Detection and Recognition in FPGA-Based Autonomous Driving Systems," *International Journal of Computer Trends and Technology*, vol. 72, no. 4, pp. 145-152, 2024. Crossref, https://doi.org/10.14445/22312803/IJCTT-V72I4P119
54. Chandrakanth Lekkala, "*Utilizing Cloud – Based Data Warehouses for Advanced Analytics: A Comparative Study*", International Journal of Science and Research (IJSR), Volume 11 Issue 1, January 2022, pp. 1639-1643, https://www.ijsr.net/getabstract.php?paperid=SR24628182046

55. Dixit, A.S., Patwardhan, A.V. and Pandit, A.B., 2021. PARAMETER OPTIMIZATION OF PRODIGIOSIN BASEDDYE-SENSITIZED SOLAR CELL. *International Journal of Pharmaceutical, Chemical & Biological Sciences*, *11*(1), pp.19-29.
56. Dixit, A., Sabnis, A., Balgude, D., Kale, S., Gada, A., Kudu, B., Mehta, K., Kasar, S., Handa, D., Mehta, R. and Kshirsagar, S., 2023. Synthesis and characterization of citric acid and itaconic acid-based two-pack polyurethane antimicrobial coatings. Polymer Bulletin, 80(2), pp.2187-2216.
57. Sainath Muvva, 2021. "Cloud-Native Data Engineering: Leveraging Scalable, Resilient, and Efficient Pipelines for the Future of Data", ESP Journal of Engineering & Technology Advancements 1(2): 287-292.
58. M. Rele and D. Patil, "Revolutionizing Liver Disease Diagnosis: AI-Powered Detection and Diagnosis", *International Journal of Science and Research (IJSR)*, 2023.https://doi.org/10.21275/SR231105021910
59. Sateesh Reddy Adavelli, "AI and Cloud Synergy in Insurance: AWS, Snowflake, and Guidewire's Role in DataDriven Transformation", International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), Volume 12, Issue 6, June 2023.
60. Chandrakanth Lekkala 2022. "Integration of Real-Time Data Streaming Technologies in Hybrid Cloud Environments: Kafka, Spark, and Kubernetes", European Journal of Advances in Engineering and Technology, 2022, 9(10):38-43.
61. Lakshmana Kumar Yenduri, 2024. *"Low Latency High Throughput Data Serving Layer for Generative AI Applications using the REST-based APIs" ESP International Journal of Advancements in Computational Technology (ESP-IJACT)* Volume 2, Issue 3: 61-76.
62. SUNIL KUMAR SUVVARI, DR. ROHINI SAWALKAR. (2024). The Role of Leadership in Project Success: A Quantitative Analysis. International Journal of Communication Networks and Information Security (IJCNIS), 16(4), 1146–1157. Retrieved from https://ijcnis.org/index.php/ijcnis/article/view/7319
63. Bodapati, J.D., Veeranjaneyulu, N. & Yenduri, L.K. A Comprehensive Multi-modal Approach for Enhanced Product Recommendations Based on Customer Habits. J. Inst. Eng. India Ser. B (2024). https://doi.org/10.1007/s40031-024-01064-5
64. Vinay Panchal, 2025. "Designing for Longer Battery Life: Power Optimization Strategies in Modern Mobile SOCS", International Journal of Electrical Engineering and Technology (IJEET) Volume 16, Issue 1, January-February 2025, pp. 1-17, Article ID: IJEET_16_01_001 Available online at https://iaeme.com/Home/issue/IJEET?Volume=16&Issue=1
65. Sainath Muvva, "DataMesh: A Decentralized Approach to Big Data and AI/ML Management", Internaitonal Journal of Scientific Research in Engineering and Management, Volume: 08 Issue: 01 | Jan – 2024.
66. Vinay Panchal, 2024. "Thermal and Power Management Challenges in High-Performance Mobile Processors", International Journal of Innovative Research of Science, Engineering and Technology (IJIRSET), Volume 13, Issue 11, November 2024 |DOI: 10.15680/IJIRSET.2024.1311014.
67. Sunil Kumar Suvvari, "Measuring Agile Success: Metrics and Indicators for Agile Project Management", Stochastic Modelling and Computational Sciences, Vol. 1 No.2, (December, 2021).
68. Sateesh Reddy Adavelli, 2024. "Multimodal Gen AI: Integrating Text, Image, and Video Analysis for Comprehensive Claims Assessment", ESP International Journal of Advancements in Computational Technology (ESP-IJACT), Volume 2, Issue 2: 133-141.