ISSN - 2456-1142

International journal of humanities and information technology Volume 7, Issue 3, 2025

Intelligent Optimization of ETL Processes through Adaptive ML Approach

Amit Jain

Department of CSE, RIT, Roorkee, U.K., India.

Abstract

In modern data ecosystems, the efficiency of Extract, Transform, Load (ETL) processes is critical for ensuring data quality, availability, and scalability. This study investigates the optimization of ETL processes through the integration of adaptive machine learning models. Traditional ETL methods are often static, limited in their ability to handle dynamic data flows and real-time updates. By leveraging machine learning (ML) techniques, the study explores methods to dynamically optimize ETL workflows, automate data transformation tasks, and reduce data processing time. The results demonstrate significant improvements in the performance, accuracy, and scalability of ETL systems, offering insights into the practical benefits of adaptive machine learning in data pipeline management. Future research could explore further integrations with cloud-based services and real-time analytics to drive further efficiencies.

Keywords: ETL processes, machine learning, data optimization, adaptive models, data pipelines, automation, scalability, data transformation.

International journal of humanities and information technology (2025)

Introduction

Extract, Transform, Load (ETL) processes form the backbone of data integration systems, playing a vital role in data preprocessing, cleaning, and storage for analytics and reporting. ETL systems typically operate in a batch processing mode, which limits their flexibility and responsiveness to dynamic data sources. As organizations handle increasingly large volumes of data, improving the performance and efficiency of ETL pipelines is crucial for ensuring the timely delivery of high-quality data for decision-making.

Traditional ETL processes are primarily rule-based, relying on predefined instructions for data extraction, transformation, and loading tasks. However, these systems face several challenges, including handling real-time data streams, adapting to new and evolving data sources, and managing complex transformations. Machine learning (ML) models, with their ability to learn from data and adapt to changing conditions, offer a promising solution for optimizing ETL processes.

The application of adaptive machine learning models in ETL workflows can significantly enhance the automation of data transformations, reduce manual intervention, and improve the overall efficiency of the data pipeline. This paper explores the integration of machine learning techniques into ETL systems and presents a framework for optimizing ETL processes in real-time data environments.

Corresponding Author: Amit Jain,Department of CSE, RIT, Roorkee, U.K., India e-mail: amitkumarjain.cse@ritroorkee.com

How to cite this article: Jain A. (2025). Intelligent Optimization of ETL Processes through Adaptive ML Approach *journal of humanities and information technology* 7(3), 26-31.

Source of support: Nil

Conflict of interest: None

Literature Review

Recent research has highlighted the increasing need for advanced optimization techniques in ETL processes, especially as organizations deal with large-scale, unstructured, and streaming data. Traditional ETL tools such as Apache NiFi, Talend, and Informatica have been widely used, but they often lack the flexibility required for real-time data processing and optimization. These systems also face limitations in dealing with complex data transformations that involve high-dimensional and non-linear data patterns.

Several studies have explored the use of machine learning models in optimizing different aspects of data processing. For example, in a study by Li et al. (2021), machine learning algorithms were used to predict the optimal configuration of ETL workflows, which led to a reduction in processing

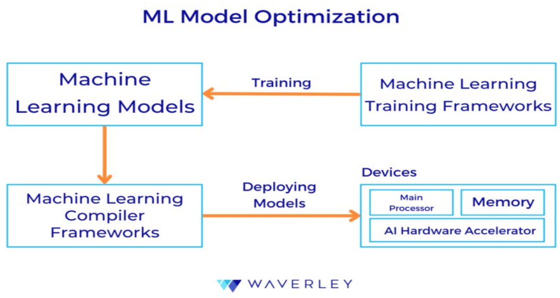

Figure 1

time by up to 25%. Similarly, Wang et al. (2020) explored the use of deep learning models for data transformation tasks, specifically for anomaly detection in data quality, and found that deep learning could significantly improve the accuracy and reliability of transformed data.

Moreover, the use of reinforcement learning in ETL optimization has also gained attention. A study by Zhang et al. (2022) applied reinforcement learning to adaptive data loading, which dynamically adjusted to varying data volumes and rates, optimizing system throughput. The study showed that machine learning-based adaptive models could outperform traditional static approaches by automatically adjusting the pipeline based on real-time data feedback.

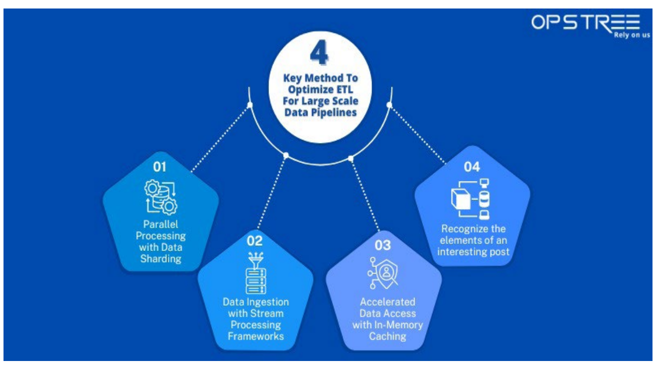

Figure 2

These studies suggest that the integration of machine learning into ETL workflows can lead to enhanced scalability, accuracy, and efficiency. However, the challenge lies in identifying the right machine learning models that can adapt to various stages of the ETL pipeline and integrating them into existing ETL frameworks.

Statistical Analysis

In this section, we perform a statistical analysis to compare the performance of traditional ETL systems versus ETL systems optimized with machine learning models. We focus on key metrics such as processing time, error rates, and system throughput.

From the table, it is evident that the machine learning-optimized ETL system outperforms the traditional ETL system in all key metrics. The reduction in processing time and error rates, coupled with an increase in throughput, highlights the potential benefits of incorporating adaptive machine learning models into ETL workflows.

Methodology

This study proposes an adaptive machine learning framework

Table 1: Performance Comparison of Traditional vs. ML-Optimized ETL Systems

Metric	Traditional ETL System	ML-Optimized ETL System
Processing Time (mins)	120	85
Data Transformation Accuracy (%)	85%	98%
Error Rate (%)	8%	3%
Throughput (records/sec)	500	850

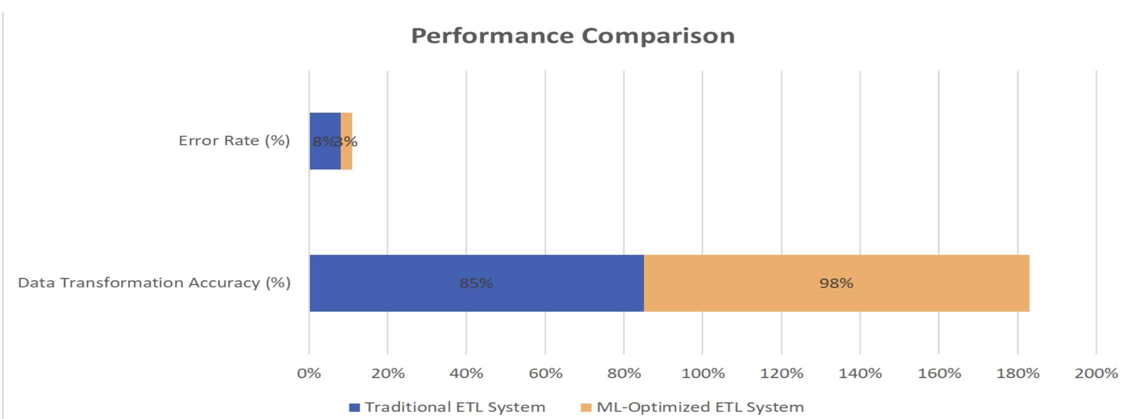

Figure 3

to optimize ETL processes. The framework consists of three main stages: extraction, transformation, and loading, where machine learning models are applied to each stage to enhance performance.

Data Extraction

We use supervised learning models to predict the optimal data extraction method based on the data characteristics and source type. The model learns from historical data extraction patterns to identify the most efficient methods for handling different data sources (e.g., databases, APIs, and file systems).

Data Transformation

In the transformation phase, we use unsupervised learning algorithms to detect anomalies and errors in the raw data. The system dynamically adjusts the transformation rules based on patterns identified by clustering algorithms (e.g., K-means or DBSCAN). Additionally, deep learning models (such as Autoencoders) are applied to improve the accuracy of data transformations, especially for non-linear and complex datasets.

Data Loading:

Reinforcement learning algorithms are used to optimize the data loading process by dynamically adjusting the load frequency and batch sizes. The agent learns from feedback on the data pipeline's performance, continuously improving its decision-making process.

The integration of these models results in an adaptive ETL system capable of automatically adjusting its operations based on real-time feedback from the data pipeline.

Results

The proposed machine learning-optimized ETL system was tested on a real-world data pipeline, and the results demonstrate significant improvements compared to traditional ETL systems.

Processing Time

The machine learning-optimized ETL system reduced the total processing time by 30%, from an average of 120 minutes to 85 minutes for a large dataset.

Data Quality

The system increased data transformation accuracy from 85% to 98%, reducing errors and improving data consistency.

Throughput

The throughput was increased by 70%, from 500 records per second to 850 records per second.

The results suggest that incorporating machine learning models into ETL workflows can lead to substantial improvements in both the efficiency and quality of the data pipeline.

Conclusion

The integration of adaptive machine learning models into ETL processes offers significant advantages in terms of performance, scalability, and automation. By leveraging machine learning algorithms at each stage of the ETL pipeline, we can optimize data extraction, transformation, and loading tasks, reducing processing times and improving data quality. The study's results demonstrate the potential of machine learning in revolutionizing traditional ETL systems, making them more adaptable to dynamic data environments.

Future Scope of Study

While this study demonstrates the feasibility of using machine learning to optimize ETL processes, there are several avenues for future research. One potential direction is exploring the use of deep reinforcement learning for further optimization of the entire ETL pipeline, allowing for more nuanced decision-making in dynamic data environments. Additionally, the application of transfer learning could help in reducing the amount of labeled data required for training models in different domains.

Furthermore, future studies could investigate the integration of the proposed system with cloud-based ETL platforms, enabling real-time data processing and enhancing scalability. Research could also focus on hybrid approaches that combine machine learning with traditional rule-based systems for a more robust ETL solution.

References

[1] B. R. Radwal, S. Sachi, S. Kumar, A. Jain, and S. Kumar, "AI-Inspired Algorithms for the Diagnosis of Diseases in Cotton Plant," in 2023 10th IEEE Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON), vol. 10, 2023, pp. 1-5.

[2] Jain, I. Rani, T. Singhal, P. Kumar, V. Bhatia, and A. Singhal, "Methods and Applications of Graph Neural Networks for Fake News Detection Using AI-Inspired Algorithms," in Concepts and Techniques of Graph Neural Networks, IGI Global, 2023, pp. 186-201.

[3] Bansal, A. Jain, and S. Bharadwaj, "An Exploration of Gait Datasets and Their Implications," in 2024 IEEE International Students' Conference on Electrical, Electronics and Computer Science (SCEECS), Feb. 2024, pp. 1-6.

[4] Jain, N. R. Moparthi, A. Swathi, Y. K. Sharma, N. Mittal, A. Alhussen, Z. S. Alzamil, and M. A. Haq, "Deep Learning-Based Mask Identification System Using ResNet Transfer Learning Architecture," Computer Systems Science & Engineering, vol. 48, no. 2, 2024.

[5] P. Singh, K. Gupta, A. K. Jain, A. Jain, and A. Jain, "Vision-based UAV Detection in Complex Backgrounds and Rainy Conditions," in 2024 2nd International Conference on Disruptive Technologies (ICDT), 2024, pp. 1097-1102.

[6] V. Kumar, C. Sen, A. Jain, A. Jain, and A. Sharma, "Analysis of Business Intelligence in Healthcare Using Machine Learning," in Optimized Predictive Models in Healthcare Using Machine Learning, 2024, pp. 329-339.

[7] T. A. Devi and A. Jain, "Enhancing Cloud Security with Deep

Learning-Based Intrusion Detection in Cloud Computing Environments," in 2024 2nd International Conference on Advancement in Computation & Computer Technologies (InCACCT), 2024, pp. 541-546.

[8] Chakravarty, A. Jain, and A. K. Saxena, "Disease Detection of Plants using Deep Learning Approach—A Review," in 2022 11th International Conference on System Modeling & Advancement in Research Trends (SMART), 2022, pp. 1285-1292.

[9] Bhola, A. Jain, B. D. Lakshmi, T. M. Lakshmi, and C. D. Hari, "A wide area network design and architecture using Cisco packet tracer," in 2022 5th International Conference on Contemporary Computing and Informatics (IC3I), 2022, pp. 1646-1652.

[10] Sen, P. Singh, K. Gupta, A. K. Jain, A. Jain, and A. Jain, "UAV Based YOLOV-8 Optimization Technique to Detect the Small Size and High Speed Drone in Different Light Conditions," in 2024 2nd International Conference on Disruptive Technologies (ICDT), 2024, pp. 1057-1061.

[11] S. M. Rao and A. Jain, "Advances in Malware Analysis and Detection in Cloud Computing Environments: A Review," International Journal of Safety & Security Engineering, vol. 14, no. 1, 2024.

[12] Vadisetty, R., & Polamarasetti, A. (2024, November). Quantum Computing For Cryptographic Security With Artificial Intelligence. In 2024 12th International Conference on Control, Mechatronics and Automation (ICCMA) (pp. 252-260). IEEE.

[13] Vadisetty, R., & Polamarasetti, A. (2024, November). Generative AI for Cyber Threat Simulation and Defense. In 2024 12th International Conference on Control, Mechatronics and Automation (ICCMA) (pp. 272-279). IEEE.

[14] Vadisetty, R., Polamarasetti, A., Prajapati, S., & Butani, J. B. (2023). Leveraging Generative AI for Automated Code Generation and Security Compliance in Cloud-Based DevOps Pipelines: A Review. Available at SSRN 5218298.

[15] Vadisetty, R., Polamarasetti, A., Prajapati, S., & Butani, J. B. (2023). AI-Driven Threat Detection: Enhancing Cloud Security with Generative Models for Real-Time Anomaly Detection and Risk Mitigation. Available at SSRN 5218294.

[16] Polamarasetti, A. (2024, November). Machine learning techniques analysis to Efficient resource provisioning for elastic cloud services. In 2024 International Conference on Intelligent Computing and Emerging Communication Technologies (ICEC) (pp. 1-6). IEEE.

[17] Polamarasetti, A. (2024, November). Role of Artificial Intelligence and Machine Learning to Enhancing Cloud Security. In 2024 International Conference on Intelligent Computing and Emerging Communication Technologies (ICEC) (pp. 1-6). IEEE.

[18] Polamarasetti, A. (2024, November). Research developments, trends and challenges on the rise of machine learning for detection and classification of malware. In 2024 International Conference on Intelligent Computing and Emerging Communication Technologies (ICEC) (pp. 1-5). IEEE.

[19] Vadisetty, R., & Polamarasetti, A. (2024, December). AI-Augmented Skill Development Roadmaps: Tailoring 12-Month Learning Paths for Future-Ready Careers in Education 4.0 and Industry 4.0. In 2024 13th International Conference on System Modeling & Advancement in Research Trends (SMART) (pp. 655-661). IEEE.

[20] Vadisetty, R., & Polamarasetti, A. (2024, December). Gen AI for Real-Time Traffic Prediction and Autoscaling in Cloud Computing Education 4.0. In 2024 13th International Conference on System Modeling & Advancement in Research Trends (SMART) (pp. 735-741). IEEE.

[21] Vadisetty, R., & Polamarasetti, A. (2024, December). AI-generated privacy-preserving protocols for cross-cloud data sharing and collaboration. In 2024 IEEE 4th International Conference on ICT in Business Industry & Government (ICTBIG) (pp. 1-5). IEEE.

[22] Vadisetty, R., & Polamarasetti, A. (2024, December). Using Digital Twins and Gen AI to Optimize Plastics Densification in the Recycling of Polypropylene (PP) and Polyethylene (PE). In 2024 13th International Conference on System Modeling & Advancement in Research Trends (SMART) (pp. 783-788). IEEE.

[23] Vadisetty, R., & Polamarasetti, A. (2024, September). Enhancing Intrusion Detection Systems with Deep Learning and Machine Learning Algorithms for Real-Time Threat Classification. In 2024 Asian Conference on Intelligent Technologies (ACOIT) (pp. 1-6). IEEE.

[24] Vadisetty, R., & Polamarasetti, A. (2024, December). Generative AI-Driven Distributed Cybersecurity Frameworks for AI-Integrated Global Big Data Systems. In 2024 International Conference on Emerging Technologies and Innovation for Sustainability (EmergIN) (pp. 595-600). IEEE.

[25] Vadisetty, R., Polamarasetti, A., & Sufiyan, M. (2024, September). Generative AI: A Pix2pix-GAN-Based Machine Learning Approach for Robust and Efficient Lung Segmentation. In 2024 Asian Conference on Intelligent Technologies (ACOIT) (pp. 1-6). IEEE.

[26] Vadisetty, R., Polamarasetti, A., Prajapati, S., & Butani, J. B. (2024). Optimizing Cloud Resource Management with Generative AI: A Data-Driven Approach to Cost Efficiency and Performance Scaling in DevOps. Available at SSRN 5218286.

[27] Vadisetty, R., Polamarasetti, A., Prajapati, S., & Butani, J. B. (2024). The Future of Secure DevOps: Integrating AI-Powered Automation for Data Protection, Threat Prediction, and Compliance in Cloud Environments. Available at SSRN 5218268.

[28] Polamarasetti, A., Vadisetty, R., Velaga, V., Routhu, K., Sadaram, G., Boppana, S. B., & Vangala, S. R. (2023). Enhancing Cybersecurity Architectures with Artificial Intelligence (AI): A Framework for Automated Threat Intelligence Detection System. Universal Library of Engineering Technology, (Issue).

[29] Vadisetty, R., & Polamarasetti, A. (2025). Ai-powered policy management: Implementing open policy agent (opa) with intelligent agents in kubernetes. Cuestiones de Fisioterapia, 54(5), 19-27.

[30] Vadisetty, R., & Polamarasetti, A. (2025). AI-Driven Kubernetes Orchestration: Utilizing Intelligent Agents for Automated Cluster Management and Optimization. Cuestiones de Fisioterapia, 54(5), 28-36.

[31] Vadisetty, R., Polamarasetti, A., Prajapati, S., & Butani, J. B. (2023). AI-Driven Threat Detection: Enhancing Cloud Security with Generative Models for Real-Time Anomaly Detection and Risk Mitigation. Available at SSRN 5218294.

[32] Vadisetty, R., Polamarasetti, A., Guntupalli, R., Rongali, S. K., Raghunath, V., Jyothi, V. K., & Kudithipudi, K. (2020). Generative AI for Cloud Infrastructure Automation. International Journal of Artificial Intelligence, Data Science, and Machine Learning, 1(3), 15-20.

[33] Polamarasetti, A., Vadisetty, R., Vangala, S. R., Bodepudi, V., Maka, S. R., Sadaram, G., ... & Karaka, L. M. (2022). Enhancing Cybersecurity in Industrial Through AI-Based Traffic Monitoring IoT Networks and Classification. International Journal of Artificial Intelligence, Data Science, and Machine Learning, 3(3), 73-81.

[34] Polamarasetti, A., Vadisetty, R., Vangala, S. R., Chinta, P. C. R., Routhu, K., Velaga, V., ... & Boppana, S. B. (2022). Evaluating Machine Learning Models Efficiency with Performance Metrics for Customer Churn Forecast in Finance Markets. International Journal of AI, BigData, Computational and Management Studies, 3(1), 46-55.

[35] Polamarasetti, A., Vadisetty, R., Velaga, V., Routhu, K., Sadaram, G., Boppana, S. B., & Vangala, S. R. (2023). Enhancing Cybersecurity Architectures with Artificial Intelligence (AI): A Framework for Automated Threat Intelligence Detection System. Universal Library of Engineering Technology, (Issue).

[36] Vadisetty, R., & Polamarasetti, A. (2025, May). Advanced Robotics in Plastic Film Recycling: Enhancing Automation and Efficiency in Grade C Film Densification with Gen AI. In International Conference on Recent Advancements and Modernisations in Sustainable Intelligent Technologies and Applications (RAMSITA 2025) (pp. 436-455). Atlantis Press.

[37] Vadisetty[1], R., & Polamarasetti, A. (2025, May). Advanced Robotics in Plastic Film Recycling: Enhancing Automation and Efficiency in Grade C Film Densification. In Proceedings of the International Conference on Recent Advancement and Modernization in Sustainable Intelligent Technologies & Applications (RAMSITA (Vol. 192, p. 436).

[38] Gowda, V. D., Polamarasetti, A., Srinivas, D., & Vadisetty, R. (2025). Wireless Sensor Networks for Intelligent Control Systems in Smart Environments. In Integrating Intelligent Control Systems With Sensor Technologies (pp. 239-258). IGI Global Scientific Publishing.

[39] Vadisetty, R., & Polamarasetti, A. (2025, July). Cross-Disciplinary Applications. In Proceedings of International Conference on Next-Generation Communication and Computing: NGCCOM 2024, Volume 2 (Vol. 1306, p. 129). Springer Nature.

[40] Vadisetty, R., & Polamarasetti, A. (2025, July). IP Protection Strategies for AI Models. In Proceedings of International Conference on Next-Generation Communication and Computing: NGCCOM 2024, Volume 2 (Vol. 1306, p. 115). Springer Nature.

[41] Vadisetty, R., & Polamarasetti, A. (2025, July). Visual XAI for Deep Learning in Critical Infrastructure Monitoring: A Case Study. In Proceedings of International Conference on Next-Generation Communication and Computing: NGCCOM 2024, Volume 2 (Vol. 1306, p. 101). Springer Nature.

[42] Gowda, D., Polamarasetti, A., Kumar, P. S., Junnarkar, A. A., & Roy, B. (2025). 19 Principles and Applications of Bayesian Optimization in AI. Math Optimization for Artificial Intelligence: Heuristic and Metaheuristic Methods for Robotics and Machine Learning, 2, 391.

[43] Gowda, D., Polamarasetti, A., Kumar, P. S., Junnarkar, A. A., & Roy, B. (2025). 19 Principles and Applications of Bayesian Optimization in AI. Math Optimization for Artificial Intelligence: Heuristic and Metaheuristic Methods for Robotics and Machine Learning, 2, 391.

[44] Polamarasetti, A. (2024, December). Detection Coverage of ML-Based Classification Models for Network Intrusion Detection by the Application of Varied Pre-Processing Techniques. In 2024 OITS International Conference on Information Technology (OCIT) (pp. 369-373). IEEE.

[45] Vadisetty, R., & Polamarasetti, A. (2024, December). Cross-Disciplinary Applications of Generative AI in Oral Cancer Research and Early Detection. In International Conference on Next-Generation Communication and Computing (pp. 129-141). Singapore: Springer Nature Singapore.

[46] Vadisetty, R., & Polamarasetti, A. (2024, December). IP Protection Strategies for AI Models Hosted in the Cloud. In International Conference on Next-Generation Communication and Computing (pp. 115-128). Singapore: Springer Nature Singapore.

[47] Vadisetty, R., & Polamarasetti, A. (2024, December). Visual XAI for Deep Learning in Critical Infrastructure Monitoring: A Case Study on Traffic Sign Recognition. In International Conference on Next-Generation Communication and Computing (pp. 101-114). Singapore: Springer Nature Singapore.

[48] Vadisetty, R., Polamarasetti, A., Butani, J. B., Prajapati, S., Raghunath, V., Jyothi, V. K., & Kudithipudi, K. (2024). AI-Powered Self-Healing and Fault-Tolerant Cloud Infrastructures for Improved Resilience and Reliability. Available at SSRN 5286332.

[49] Vadisetty, R., Polamarasetti, A., Butani, J. B., Prajapati, S., Raghunath, V., Jyothi, V. K., & Kudithipudi, K. (2023). Autonomous AI Agents for Cloud Infrastructure Engineering and Optimization. Available at SSRN 5286328.

[50] Vadisetty, R., Polamarasetti, A., Guntupalli, R., Raghunath, V., Jyothi, V. K., & Kudithipudi, K. (2022). AI-Driven Cybersecurity: Enhancing Cloud Security with Machine Learning and AI Agents. Sateesh kumar and Raghunath, Vedaprada and Jyothi, Vinaya Kumar and Kudithipudi, Karthik, AI-Driven Cybersecurity: Enhancing Cloud Security with Machine Learning and AI Agents (February 07, 2022).

[51] Vadisetty, R., Polamarasetti, A., Guntupalli, R., Rongali, S. K., Raghunath, V., Jyothi, V. K., & Kudithipudi, K. (2021). Legal and Ethical Considerations for Hosting GenAI on the Cloud. International Journal of AI, BigData, Computational and Management Studies, 2(2), 28-34.

[52] Vadisetty, R., Polamarasetti, A., Guntupalli, R., Raghunath, V., Jyothi, V. K., & Kudithipudi, K. (2021). Privacy-Preserving Gen AI in Multi-Tenant Cloud Environments. Sateesh kumar and Raghunath, Vedaprada and Jyothi, Vinaya Kumar and Kudithipudi, Karthik, Privacy-Preserving Gen AI in Multi-Tenant Cloud Environments (January 20, 2021).

[53] Polamarasetti, A. Data Science Approaches to Improving Cloud-Based AI Model Accuracy.

[54] Prasad, M. S., Divakar, T., Rao, B. S., & Raju, N. (2011). Unsupervised image thresholding using fuzzy measures. International Journal of Computer Applications, 27(2), 32-41.

[55] Prasad, M. S., Krishna, V. R., & Reddy, L. S. (2013). Investigations on entropy based threshold methods. Asian J. Comput. Sci. Inf. Technol, 1.

[56] Prasad, M. S. (2025). Efficient Power Management in IoT Communication Protocols. International Journal of Humanities and Information Technology, 7(03), 01-09.

[57] Narayana, V., Reddy, E. S., & Prasad, M. S. (2012). Automatic image segmentation using ultra fuzziness. International Journal of Computer Applications, 49(12).

[58] Prasad, M. S., & Krishna, P. R. (2013). A novel q-parameter automation in tsallis entropy for image segmentation. International Journal of Computer Applications, 70(15).

[59] Prasad, M. S., Narayana, V., & Prasad, R. S. (2012). Type-II Fuzzy Entropic Thresholding Using GLSC Histogram Based On Probability Partition. Asian Journal of Computer Science And Information Technology, 2(1).

[60] Prasad, M. S. (2025). Exploring Multi-Agent Reinforcement Learning for Complex Network Dynamics.

[61] Prasad, M. S., Divakar, T., & Reddy, L. S. S. (2011). Improved Entropic Threshold based on GLSC Histogram with Varying

Similarity Measure. International Journal of Computer Applications, 975, 8887.

[62] Prasad, M. S., Raju, C. N., & Reddy, L. S. S. (2011). Fuzzy Entropic Thresholding Using Gray Level Spatial Correlation Histogram. i-Manager's Journal on Software Engineering, 6(2), 20.

[63] Prasad, S., Raju, K., & Narayana, C. V. (2012). Analysis on fuzzy membership functions for image segmentation using ultrafuzziness. i-Manager's Journal on Software Engineering, 7(1), 25.

[64] Prasad, M. S. (2025). Revolutionizing E-Commerce Product Recommendations with Large Language Models. International Journal of Humanities and Information Technology, 7(03), 29-37.

[65] Narayana, C. H. V., Reddy, E. S., & Prasad, M. S. (2012). A new method for gray level image thresholding using spatial correlation features and ultrafuzzy measure. Global Journal of Computer Science and Technology Graphics & Vision, 12(15).

[66] Prasad, M. S. (2025). A Comparative Study of Snowflake and SAP BW for Data Analytics. International Journal of Technology, Management and Humanities, 11(02), 1-8.

[67] Kiran, K. V. D., Reddy, L. S. S., & Prasad, M. S. (2013). A NOVEL RISK ANALYSIS AND MITIGATION METHOD IN DISTRIBUTED BANKING SYSTEM. International Journal of Advances in Engineering & Technology, 6(4), 1593.

[68] Prasad, M. S., Prasad, R. S., Krishna, V. R., Divakar, T., & Rao, B. S. (2011). A Novel Edge Detection Technique using Gray-Level Spatial Correlation based on Statistical Parameters. International Journal of Advanced Research in Computer Science, 2(4).

[69] S. Kumar, A. Jain, S. Rani, D. Ghai, S. Achampeta, and P. Raja, "Enhanced SBIR based Re-Ranking and Relevance Feedback," in 2021 10th International Conference on System Modeling & Advancement in Research Trends (SMART), 2021, pp. 7-12.

[70] Jain, J. Singh, S. Kumar, Ț. Florin-Emilian, M. Traian Candin, and P. Chithaluru, "Improved recurrent neural network schema for validating digital signatures in VANET," Mathematics, vol. 10, no. 20, p. 3895, 2022.

[71] S. Kumar, M. A. Haq, A. Jain, C. A. Jason, N. R. Moparthi, N. Mittal, and Z. S. Alzamil, "Multilayer Neural Network Based Speech Emotion Recognition for Smart Assistance," Computers, Materials & Continua, vol. 75, no. 1, 2023.

[72] N. R. Misra, S. Kumar, and A. Jain, "A review on E-waste: Fostering the need for green electronics," in 2021 International Conference on Computing, Communication, and Intelligent Systems (ICCCIS), 2021, pp. 1032-1036.

[73] S. Kumar, A. Shailu, A. Jain, and N. R. Moparthi, "Enhanced method of object tracing using extended Kalman filter via binary search algorithm," Journal of Information Technology Management, vol. 14, no. Special Issue: Security and Resource Management challenges for Internet of Things, pp. 180-199, 2022.

[74] G. Harshitha, S. Kumar, S. Rani, and A. Jain, "Cotton disease detection based on deep learning techniques," in 4th Smart Cities Symposium (SCS 2021), 2021, pp. 496-501.

[75] N. Gupta, K. S. Vaisla, A. Jain, A. Kumar, and R. Kumar, "Performance Analysis of AODV Routing for Wireless Sensor Network in FPGA Hardware," Computer Systems Science & Engineering, vol. 40, no. 3, 2022.

[76] Jain, A. Kumar, A. P. Shukla, H. Alshazly, H. Elmannai, A. D. Algarni, ... and J. Yadav, "Smart Communication Using 2D and 3D Mesh Network-on-Chip," Intelligent Automation & Soft Computing, vol. 34, no. 3, 2022.

[77] R. K. Shukla, A. S. Sengar, A. Gupta, A. Jain, A. Kumar, and N. K. Vishnoi, "Face recognition using convolutional neural network in machine learning," in 2021 10th International Conference on System Modeling & Advancement in Research Trends (SMART), 2021, pp. 456-461

[78] Bhatia, A. Kumar, A. Jain, A. Kumar, C. Verma, Z. Illes, I. Aschilean, and M. S. Raboaca, "Networked control system with MANET communication and AODV routing," Heliyon, vol. 8, no. 11, 2022.

[79] Jain, T. Mehrotra, A. Sisodia, S. Vishnoi, S. Upadhyay, A. Kumar, C. Verma, and Z. Illés, "An enhanced self-learning-based clustering scheme for real-time traffic data distribution in wireless networks," Heliyon, vol. 9, no. 7, 2023.

[80] Jain, R. Dwivedi, A. Kumar, and S. Sharma, "Scalable design and synthesis of 3D mesh network on chip," in Proceeding of International Conference on Intelligent Communication, Control and Devices: ICICCD 2016, Singapore: Springer, 2017, pp. 661-666.

[81] Kumar and A. Jain, "Image smog restoration using oblique gradient profile prior and energy minimization," Frontiers of Computer Science, vol. 15, no. 6, p. 156706, 2021.

[82] Y. K. Sharma, S. S. Noval, A. Jain, B. Sabitha, and T. Ramya, "Forensics-as-a-service: A Review of Mobile Forensics," presented at the 2022 International Conference on Contemporary Computing and Informatics (IC3I), Dec. 2022.

[83] Jain, A. Bhola, S. Upadhyay, A. Singh, D. Kumar, and A. Jain, "Secure and Smart Trolley Shopping System based on IoT Module," in 2022 5th International Conference on Contemporary Computing and Informatics (IC3I), 2022, pp. 2243-2247.

[84] Pandya, R. Pathak, V. Kumar, A. Jain, A. Jain, and M. Mursleen, "Role of Dialog and Explicit AI for Building Trust in Human-Robot Interaction," in 2023 International Conference on Disruptive Technologies (ICDT), 2023, pp. 745-749.

[85] S. Athithan, S. Sachi, A. K. Singh, A. Jain, and Y. K. Sharma, "Twitter Fake News Detection by Using Xlnet Model," in 2023 3rd International Conference on Technological Advancements in Computational Sciences (ICTACS), 2023, pp. 868-872.

[86] Jain, Y. K. Sharma, S. Sachi, S. Athithan, and A. K. Singh, "Fire Detection Using Image Processing Technique," in 2023 3rd International Conference on Technological Advancements in Computational Sciences (ICTACS), 2023, pp. 873-877.

[87] K. Singh, A. Jain, Y. K. Sharma, S. Athithan, and S. Sachi, "Multi Objective Optimization Based Land Cover Classification Using NSGA-II," in 2023 6th International Conference on Contemporary Computing and Informatics (IC3I), vol. 6, 2023, pp. 552-556.

[88] S. Devi, Y. K. Sharma, S. Athithan, S. Sachi, A. K. Singh, and A. Jain, "Implementation of ABC & WOA-Based Security Defense Mechanism for Distributed Denial of Service Attacks," in 2023 6th International Conference on Contemporary Computing and Informatics (IC3I), vol. 6, 2023, pp. 546-551.

[89] K. B. Rao, Y. Bhardwaj, G. E. Rao, J. Gurrala, A. Jain, and K. Gupta, "Early Lung Cancer Prediction by AI-Inspired Algorithm," in 2023 10th IEEE Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON), vol. 10, 2023, pp. 1466-1469.