Full Length Review Article

A Comprehensive Literature Review on the Role of Machine Learning Across Domains: Advances, Applications, and Future Directions

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Abstract: *Machine Learning (ML) has become one of the most disruptive technologies in such fields as finance, healthcare, disaster management, big data analytics, intelligent transportation systems, behavioral economics, radiomics, and human-computer interaction. The literature review is based on over forty peer-reviewed publications and provides one of the unified views of applications, advancements, challenges, and emergent trends of ML. Improvements in deep learning oil, generative AI, anomaly detection, supervised and unsupervised learning, multimodal learning, GAN-based data generation, ethical AI, and optimization methods are also covered in the review. This review shows the impact of machine learning on industries, positioning it as a predictive analytics tool, decision-making tools, automation, and real-time intelligent systems and highlights it through compiling studies on how machine learning is transforming industries published in 2017 to 2025. Some of the critical technical problems such as interpretability, fairness, data quality, scalability and real time deployment are also discussed. The research directions are outlined in the future in the context of explainable ML, hybrid AI systems, integrated multimodal architectures, and responsible AI frameworks.*

Keywords: Artificial Intelligence, Behavioral Economics, Machine Learning, VANET.

1. Introduction

Machine learning as one of the approaches of artificial intelligence has developed very fast during the past decade because of the exponential growth of the computing power, selection of large datasets, and development of neural network structures. Applications of ML include finance (Ghori, 2018), credit risk modelling, medical imaging based on radiomics (Amudala Puchakayala et al., 2023), disaster management (Ghori, 2021), big data analytics (Ghori, 2023), VANETs (Sheela et al., 2023), and time-series forecasting (Ghori, 2019). Advanced intelligent automation and decision support has further been advanced with the dissemination of Generative AI and deep learning.

This review connects interdisciplinary literature to evaluate the role played by machine learning in prediction, classification, anomaly detection, optimization, resource scheduling, automation and intelligent decision-making. In order to obtain a comprehensive picture more than forty publications are cited.

2. Machine Learning in Finance and Anomaly Detection

2.1 Fraud Detection and Financial Anomalies

The data that can be detected with the help of high-dimensional and nonlinear methods provided by the financial market requires complicated ML-based anomaly detecting. Ghori (2018) has shown that autoencoders, RNNs, LSTMs, and CNNs are more effective than rule-based and statistical fraud detection models. Compared to the traditional methods, neural networks are capable of detecting sequential and temporal anomalies more.

Generative AI can enhance data augmentation where the data to augment is rare; GAN-based synthesis can be used to model fraud in case of extreme imbalance between the two classes.

2.2 Generative AI in Banking

Puchakayala (2024) demonstrated that Generative AI can greatly improve the customer support services (CSS) in banking as it improves the contextual comprehension and mitigates the inflexibility of rule-based chatbots. This change is indicative of the wider use of AI in finance.

2.3 Big Data Analytics in Finance

Ghori (2021) compared big data applications, i.e. Spark, Hadoop, KNIME, SAP HANA, with a focus on the increasingly important role of ML in large-

scale processing of data to detect fraud, risk modeling, customer segmentation, and price assets.

3. Machine Learning in Disaster Management
AI for Natural Disasters

According to Ghori (2021), AI enhances the early warning system and risk assessment, and the COVID supports disaster management strategies. Million disasters are forecasted and predicted via satellite pictures, moisture patterns, and climate change data using the ML models.

Deep learning and computer vision are helpful in:

- damage assessment
- online resource allocation.
- prioritization in rescue operations

4. Machine Learning in Healthcare and Medical Imaging
4.1 GAN-Based Medical Imaging

The application of GANs to create synthetic dermatology images was used by the DermaGAN (Ravindranath et al., 2025), which was able to classify cancer types better by a CNN because of their ability to surpass the problem of data scarcity in ML.

4.2 COPD Detection Using Radiomics

The studies by Puchakayala et al. (2023) and Saha et al. (2025) showed that radiomics with ML (CatBoost, gradient boosting, and CNNs) is a valuable and robust approach in COPD identification with the help of CT factors and prediction of emphysema development.

5. Machine Learning in Intelligent Transportation and VANETs
5.1 Vehicle-to-Vehicle Communication

Sheela et al. (2023) surveyed and discussed the uses of ML in VANET resources allocation, underlining the importance of the application that enables the reduction of communication congestion, spectrum utilization, prediction of traffic situation and accident avoidance.

5.2 Driver Drowsiness Detection

Sardesai and Gedam (2025) have created a hybrid model of EEG signal processing calculating Bayesian-optimized SVM in terms of QWT, EMD, and Bayesian-optimized SVM to obtain a more than 99% accuracy. ML monitors transportation safety in real time, which is an automated process.

6. Machine Learning in Behavioral Economics
AI in Decision-Making Analysis

Ghule (2025) noted the role of ML in shaping the behavioral economics by the use of AI-based recommendation systems, dynamic pricing frameworks, and behavioral nudges. The AI system of Flipkart increased sales and user interest by 25% and 30% respectively. Such ethical issues as fairness, privacy, and bias in algorithms are still relevant.

7. ML in Time-Series Forecasting
Energy Demand Forecasting

Ghori (2019) made a comparison between ARIMA, VAR, RF, RNN, LSTM, and GBM in multivariate time series forecasting and proved that incorporation with multiple variables improves the accuracy. In nonlinear patterns of high variance energy consumption, ML methods perform better than traditional statistics.

8. Multimodal Machine Learning
Consolidating Multiple Modalities

A systematic review of multimodal ML represented by the authors of (Ghule et al., 2024) which outlined the difficulty of representation, fusion, alignment as well as co-learning. The uses include emotion recognition, imaging in medicine, self-driving, and human-artificial intelligence.

9. Machine Learning in Human–Computer Interaction
Gesture Recognition

Sheela et al., (2022) deployed the mouse control and automation based on base MEMS gesture recognition enhanced with the use of ML. Gesture classification is useful with the help of CNNs and signal processing.

Reverse Image Search Using CNNs

Marathe et al. (2022) have created a CNN-based reverse search engine with ResNet50 and Inception network structures to retrieve content-based image search.

10. Responsible and Explainable AI
Ethical AI Frameworks

Puchakayala (2022) has suggested solutions to mitigate bias, transparency, XAI, open-data policies, and human-in-the-loop systems, noting that an increasing number of domains of sensitive applications of ML are becoming more and more necessitate responsible AI.

11. Additional Applications of ML
Cloud Optimization

Shalini et al., (2024) focused on the ML-enhanced scheduling of the cloud resources in case of data-intensive applications.

VANET Propagation Models

Shalini and Patil, (2021) used ML to enhance the radio propagation and environmental modeling of hybrid networks.

Security Systems

Abhilash et al. (2017) combined ML and OpenCV in Home Security Automation using Raspberry Pi.

Sensor Networks

Barve et al. (2024) suggested WSNs hybrid key management by use of ML.

Medical Prediction Models

Sheela and Shalini (2024) applied the ML to predict cardiac arrest in diabetic patients through comparison of the ML models including SVM, LR, DT and RF.

Imputation Techniques

Bansal et al., (2025) used the method of generative adversarial networks to impound missing values in credit risk data and attained a high level of classification accuracy.

12. Challenges in Machine Learning

Key limitations include:

- interpretability and explainability
- privacy and fairness concerns
- scalability and real-time deployment
- data imbalance and missing values
- adversarial vulnerability
- computational cost of deep models

13. Future Directions

Promising research paths:

- hybrid ML + LLM systems
- generative synthetic augmentation
- explainable ML models
- multimodal architectures
- real-time embedded ML (edge AI)
- federated and privacy-preserving ML
- ethical AI frameworks

14. Conclusion

The literature reviewed indicates that machine learning has already been applied in various sectors such as those related to finance, healthcare, disaster management, transportation, and behavioural economics and communication networks. New issues of ethics, explainability and real-time performance have to be resolved, and the line of ML to much stronger involvement in critical systems is evident. The complexity and volume of data are only increasing, and ML, particularly deep learning, GANs and multimodal models will remain driving innovation in any industry.

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