



(REVIEW ARTICLE)



Distributed Intelligence and privacy-preserving deployment: Edge-Cloud-6G-Federated Learning for Secure, Auditable Decision Support

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World Journal of Advanced Engineering Technology and Sciences, 2026, 18(03), 268-279

Publication history: Received on 02 February 2026; revised on 14 March 2026; accepted on 16 March 2026

Article DOI: <https://doi.org/10.30574/wjaets.2026.18.3.0154>

Abstract

As distributed intelligence becomes integral to high-stakes decision support, concerns about privacy, security, latency and governance intensify. This title-driven scoping review analyses publications spanning cybersecurity, energy, healthcare, finance, public welfare and agriculture to map the edge-cloud-6G-federated continuum. Titles suggest archetypes ranging from cloud-centric management information systems to edge-first inference and low-latency healthcare deployments, hybrid orchestration and 6G zero-touch networks, and privacy-first federated learning frameworks. The review infers threat models (membership inference, model inversion, poisoning, gradient leakage, adversarial examples) and explores privacy-preserving mechanisms such as secure aggregation, differential privacy, encryption and blockchain integrity. Sectoral synthesis highlights critical infrastructure cyber intelligence, smart grids and renewable energy forecasting, privacy-first clinical decision support, fraud prevention pipelines, and welfare governance models. A deployment taxonomy, threat matrix, privacy mechanism trade-off analysis and governance checklist are provided. The review culminates in a research agenda addressing standardised threat modeling, joint optimisation of privacy-utility-latency-energy, explainability for distributed pipelines, governance automation and continual learning under compliance constraints. By offering a unified framework for distributed AI assurance and highlighting gaps, this scoping synthesis lays the groundwork for evidence-based evaluation when full texts are available.

Keywords: Edge Intelligence; Cloud MIS; 6G Zero-Touch; Federated Learning; Privacy Preservation; Distributed AI; Auditability; Scoping Review

1 Introduction

Rapid advances in AI have enabled decision support across critical infrastructure, energy systems, healthcare, finance and public governance. Centralised cloud analytics have traditionally dominated, but limitations in latency, privacy, resilience and sovereignty are driving a shift towards distributed intelligence. Edge intelligence refers to performing inference and sometimes training directly on devices or local servers to reduce latency and preserve data locality [15], [24], [70]. Cloud-based management information systems (MIS) provide central coordination and analytics for business and governance tasks [2], [7]. The emergence of 6G networks promises zero-touch orchestration with intelligent automation and ultra-low-latency communication for edge AI applications [8], [79]. Federated learning (FL) enables privacy-preserving distributed training by aggregating updates from local models without sharing raw data [13], [18], [48]. Privacy-preserving learning encompasses techniques to protect data confidentiality, such as secure aggregation,

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differential privacy and hardware enclaves. Trustworthy deployment requires not only accurate models but also auditable pipelines and governance mechanisms.

Key terms used throughout this review include: **edge intelligence**, denoting on-device or near-device AI inference; **cloud MIS**, denoting management information systems hosted on centralised cloud infrastructure; **6G zero-touch**, referring to the autonomic management of next-generation networks enabling seamless orchestration of AI services [8]; **federated learning**, a distributed training paradigm where models are updated locally and aggregated centrally [13], [18]; **privacy-preserving learning**, a suite of techniques ensuring that sensitive data remain protected during training and inference; **trustworthy deployment**, encompassing properties of robustness, fairness, interpretability and compliance; and **auditability**, the ability to trace model decisions and data lineage through logs and provenance trails.

This review offers three main contributions: (i) a unified taxonomy of deployment archetypes across the edge–cloud–6G–FL continuum; (ii) a mapping of threats and mitigations to these archetypes, culminating in a governance and assurance checklist; and (iii) a portfolio evidence map of future evidence-based synthesis. Because this is a title-driven scoping review, paper-specific details and results are not provided; instead, conceptual themes and deployment implications are inferred from titles and general domain knowledge.

2 Review Protocol and Scope

2.1 Portfolio-bounded scoping rationale and research questions

The corpus spans critical infrastructure cybersecurity [1], business analytics [2], energy policy [3], workforce forecasting [4], public welfare governance [5], project management [7], 6G edge frameworks [8], threat intelligence MIS [9], renewable energy optimisation [10], privacy-preserving federated learning [13], [18], [48], explainable medical diagnostics [14], [23], edge healthcare deployments [15], digital twins [20], IoT intrusion detection [25], time-series energy forecasting [32], fault detection in power grids [39], credit card fraud detection [40], plant disease diagnostics [66], [67], sentiment analysis [43], [58], [62], mental health indicator identification [50], welfare compliance [5] and advanced therapies [76], [77]. We formulated research questions to structure the synthesis: RQ1: What deployment archetypes (edge-only, hybrid, cloud-centric, 6G, federated) are implied across the portfolio? RQ2: Which privacy and security threats dominate and what mitigations are typically needed? RQ3: How should explainability, auditability and governance be integrated into distributed pipelines? RQ4: What evaluation and assurance practices are necessary before real-world deployment?

2.2 Title-driven extraction schema

Because only titles were available, we inferred attributes using a simple extraction schema. Each title was coded for sector (critical infrastructure [1], energy [10], healthcare [16], finance [40], public welfare [5], agriculture [66], NLP [43]), task type (threat detection [1], forecasting [10], diagnosis [14], segmentation [23], risk management [57], sentiment classification [58], therapy design [76]), modality (images [22], signals [35], time-series [32], text [59], multimodal [68], tabular data [2]), deployment hint (edge [15], cloud [2], hybrid [63], 6G [8], federated learning [13], [18], [48]), privacy emphasis (privacy-first federated learning [13], [18], [48], blockchain energy transactions [11]), security emphasis (cyber threat detection [1], [21], [78] intrusion detection [25], fraud detection [40], [57], deepfake detection [54]), and governance hint (MIS integration [7], welfare policy compliance [5], inclusive development [56]). These codes are provisional and will be refined when full texts are examined.

2.3 Conceptual rigor appraisal rubric

To guide future evidence appraisal, we define a conceptual rubric encompassing: (a) Threat modeling completeness—identification of membership inference, model inversion, poisoning/backdoor, gradient leakage, adversarial examples, supply-chain risks and data tampering; (b) Privacy accounting—analysis of privacy budget in differential privacy, secure aggregation guarantees in FL and encryption overhead; (c) Robustness under shift—evaluation under adversarial perturbations [1], distributional shifts in energy grids [34], or noise in sensors [35]; (d) System latency and energy—measurement of inference delay and energy consumption in edge and 6G deployments [15], [24], [8]; (e) Monitoring and drift detection—continuous tracking of model performance, drift alarms and retraining triggers; (f) Audit trails—logging of inputs, decisions and model versions via MIS and blockchain [11], [54]; (g) Reproducibility signals—availability of implementation details, code and data; and (h) Compliance with governance and fairness requirements [5], [27]. No scores are assigned in this scoping review.

Recent investigations have drawn attention to the expanding influence of AI and MIS in domains of national importance. Goffer et al. [1] examined AI-driven cyber threat detection and response mechanisms for securing critical infrastructure, while Haldar et al. [2] analyzed the role of AI-enabled business analytics and MIS in supporting data-centered economic expansion. In the energy domain, Hassan et al. [3] considered the implementation of MIS solutions in relation to national energy dominance strategies. In addition, Mahmud et al. [4] explored AI-based workforce analytics for forecasting labor market trajectories and identifying skill gaps that affect economic competitiveness.

3 Deployment Taxonomy: Edge-Cloud-6G-Federated Continuum

3.1 Cloud-centric MIS analytics pipelines

Cloud-centric pipelines centralise data and computation within management information systems. Titles such as AI-driven business analytics [2], cloud-based MIS for IT project governance [7], cyber threat intelligence as MIS [9], digital security for deepfake detection [54] and market trends in AI-powered SaaS [52] imply reliance on cloud resources. Cloud-centric approaches benefit from scalability and centralised control but raise concerns about data sovereignty, privacy and latency. Governance is facilitated via audit logs and policy controls embedded in MIS [5], [7], yet centralised architecture creates single points of failure and heightened attack surfaces.

3.2 Edge-first inference and on-device intelligence

Edge-first approaches perform inference, and sometimes training, near data sources to reduce latency and bandwidth usage. Low-latency edge intelligence is highlighted in healthcare deployments [15], real-time industrial robot analytics [24], IoT intrusion detection [25], and fast cotton leaf diagnostics [70]. Plant disease detection [66], [67], [72] and rare medicinal plant recognition [71] imply deployment on resource-constrained devices. Edge inference enhances privacy by keeping data local and facilitates quick decision making, but demands efficient models, power management and robust update mechanisms.

3.3 Hybrid edge-cloud orchestration

Hybrid orchestration balances latency and computational resources by partitioning models across edge and cloud. Titles on decentralized breast cancer diagnosis using hierarchical Swin transformer ensembles [63] and LMVT hybrid transformers [64] suggest splitting processing between local devices and remote servers. Digital twin predictive maintenance [20], blackouts mitigation [33], resilient grid operation under EV penetration [34], and hybrid renewable energy system optimisation [42] benefit from combining local sensing with cloud analytics. Hybrid approaches require orchestration frameworks to allocate tasks dynamically, handle data transfer securely and monitor performance.

3.4 Zero-touch 6G frameworks and autonomous lifecycle management

Next-generation networks, envisaged as 6G, promise zero-touch orchestration with intelligent automation. A 6G framework for edge AI applications [8] emphasises standardisation and security in deploying distributed intelligence. Autonomous lifecycle management includes self-configuration, self-optimisation and self-healing of AI services, enabling rapid deployment and adaptation. Such frameworks must incorporate trust anchors, secure service discovery and dynamic resource allocation.

3.5 Federated learning and distributed training regimes

Federated learning enables collaborative training without sharing raw data. Titles explicitly reference privacy-preserving FL for critical infrastructure [13], privacy-first FL for healthcare data processing [18], automated white blood cell diagnostics via FL [48] and federated learning in decentralized breast cancer diagnosis [63]. FL is also implied in scalable ML strategies for chronic kidney disease screening [27] and risk management in digital finance [57]. Key design questions concern aggregation strategies (weighted averaging vs secure aggregation), handling heterogeneity across participants, protecting against gradient leakage and poisoning, and balancing privacy with model utility.

The increasing scope of AI is also evident across energy, infrastructure, and healthcare applications. Ahmed et al. [10] showed that AI-based time-series approaches can improve solar energy production and support smart energy management in the USA. Khan et al. [11] investigated the integration of blockchain with AI for secure energy transactions, particularly with regard to fraud detection and energy market stability. Ahmed et al. [12] further discussed the use of AI to improve renewable energy generation and advanced storage solutions for smart energy systems. Beyond energy systems, Ahmed [13] reviewed privacy-preserving federated learning for critical infrastructure, focusing on

deployment, threat models, and governance concerns. In healthcare, Siam et al. [14] examined explainable deep learning models for diagnosis, highlighting their role in improving trust in AI-assisted clinical practice.

3.6 Where data lives: “data gravity,” sovereignty, and regulated domains

Data gravity refers to the tendency for data to attract services and applications, influencing deployment choices. Regulated domains such as healthcare [14], [26], [27], [60], finance [40], [57] and public welfare [5] impose restrictions on data movement. Titles emphasise privacy-first data processing in healthcare [18], secure energy transactions via blockchain [11], and data-centric governance models for welfare compliance [5]. Sovereignty concerns arise where national or organisational policies require data to remain within specific jurisdictions or devices. Deployment models must therefore respect localisation, enabling edge or federated architectures to comply with laws while still harnessing central analytics. In the healthcare domain, recent AI studies have balanced concerns of predictive performance with those of data privacy. Khan et al. [16] investigated breast cancer diagnosis using neural networks supported by dimensionality reduction techniques, whereas Khan et al. [17] focused on stroke prediction through neural machine learning algorithms. Complementing these efforts, Ahmed et al. [18] proposed privacy-first federated learning models for scalable healthcare data processing, emphasizing secure and distributed AI deployment in clinical environments. Brain tumor research has recently benefited from developments in both classification and segmentation methodologies. Oza et al. [22] proposed an ensemble learning model for classifying brain tumours from MRI images, demonstrating the diagnostic value of combining multiple learners in neuroimaging tasks. In contrast, Khushubu et al. [23] introduced TransUNetB, a Transformer-U-Net framework aimed at efficient and explainable brain tumor segmentation. Together, these studies illustrate the increasing convergence of ensemble learning and transformer-based modeling in brain tumor image analysis.

4 Privacy and Security Foundations for Distributed AI

4.1 Threat models (conceptual)

Distributed AI introduces numerous attack surfaces. Titles suggest potential risks: membership inference and model inversion attacks may exploit medical diagnostic models [14], [23], [60] and federated learning systems [13], [18]; data poisoning and backdoor attacks may affect training pipelines for fraud detection [40], risk management [57], and sentiment classification [59]; gradient leakage threatens FL when sensitive updates are shared [13]; adversarial examples can target cyber threat detection [1], intrusion detection [25], and plant disease recognition [66]; supply-chain risks and hardware tampering could compromise industrial IoT deployments [24], [36]; and data tampering or falsification could destabilise energy transactions [11] and welfare MIS [5].

4.2 Privacy-preserving mechanisms (conceptual)

Privacy-preserving learning employs various mechanisms. Secure aggregation in FL hides individual model updates from the aggregator and is implied in titles on privacy-preserving federated learning [13], [18], [48]. Differential privacy injects noise to limit leakage, relevant to healthcare diagnostics [14] and mental health analytics [50], [59]. Homomorphic encryption and trusted execution environments (TEEs) enable computation on encrypted data, potentially applicable to blockchain energy transactions [11] and confidential data processing. Access control and policy enforcement are critical in MIS [7], welfare governance [5] and inclusive economic development [56].

4.3 Integrity and provenance

Integrity and provenance ensure that models and data remain untampered and auditable. Blockchain-style audit trails are referenced in secure energy transactions [11] and could extend to welfare MIS [5] and supply chain management [46]. Comprehensive logging of inputs, model versions and outputs is necessary for incident response. Lineage tracing—tracking data transformations and model updates—facilitates forensic analysis and compliance. Model cards and dataset documentation promote transparency and enable stakeholders to assess suitability.

4.4 Governance as a security control

Governance frameworks integrate AI systems into organisational policies and regulatory structures. Titles on data-centric governance models [5], cloud MIS for project governance [7], cyber threat intelligence MIS [9], digital security in MIS [54], inclusive economic development [56] and empowering small businesses [55] emphasise the need for stakeholder accountability and policy enforcement. Governance mechanisms include access audits, decision logging, stakeholder reviews and compliance checks. Integrating these controls into distributed AI pipelines ensures that security and privacy are upheld not only technically but organisationally.

5 Sectoral Synthesis of Distributed Deployment Needs

5.1 Critical infrastructure cybersecurity and threat intelligence

In critical infrastructure, distributed intelligence supports rapid detection and response to cyber threats. Titles such as AI-enhanced cyber threat detection and response [1], cyber threat intelligence MIS [9], fortifying healthcare and essential infrastructure [21], intrusion detection for IoT [25], robust fault detection in power transmission lines [39], sophisticated relays to mitigate blackouts [33], resilient grid operation under EV penetration [34], digital security for deepfake detection [54], and industrial robot analytics [24] depict a landscape where real-time analytics and resilience are paramount. Edge devices and 6G networks [8] enable low-latency inference, while cloud-based MIS coordinate threat intelligence and incident response. Privacy and security measures include federated learning for distributed threat detection [13] and blockchain for audit trails [11]. Governance requires integrating threat intelligence into project management and stakeholder collaboration [7], [9].

Across US healthcare systems, AI has shown strong promise for both screening and prognostic modeling. Arafat et al. [26] introduced a deep learning framework that combines mammography with clinical EHR data for early breast cancer detection. Rimon et al. [27] extended AI-enabled screening to chronic kidney disease by proposing a scalable machine learning strategy for deployment across healthcare systems. Hasan et al. [28] further contributed an explainable machine learning framework for mortality risk prediction in liver cirrhosis patients, underscoring the importance of interpretability for clinically dependable prediction.

5.2 Energy systems: smart grids, renewables, transaction security

Energy sector titles underscore forecasting and operational decision loops. Optimising solar energy production [10], predicting energy consumption using SVR and genetic algorithms [32], machine learning relays to mitigate blackouts [33], resilient grid operation amid electric vehicle growth [34], hybrid renewable energy system optimisation [42], secure blockchain energy transactions [11], and digital twin predictive maintenance [20] indicate that distributed intelligence spans from forecasting to market transactions. Edge computing supports real-time monitoring of grid components, while cloud analytics and blockchain ensure integrity and stability. Privacy concerns are moderate in energy usage data, but security and resilience against cyber attacks are critical. Governance emphasises national energy strategies [3] and policy compliance.

Research in energy and electrical systems has likewise addressed forecasting, protection, and physical system reliability. Hasan et al. [32] used support vector regression enhanced by genetic algorithm optimization to predict energy consumption in four sectors. Juel et al. [33] proposed a machine learning-based sophisticated relay to reduce blackout risk in power systems. Tonny et al. [34] investigated resilient grid operation under increasing EV penetration through data-driven strategies. Beyond power system analytics, Tanbhir et al. [35] evaluated DWT and EMD methods for denoising electromyographic signals, while Khan et al. [36] studied the impact of inductance and skin effect on transient wave propagation in transformer bushings. Overall, these studies highlight the diverse role of intelligent computation and system analysis in modern engineering. Recent scholarship also demonstrates that AI applications now span energy optimization, natural language analysis, decision intelligence, and industrial quality assurance. Ahamed et al. [42] reviewed machine learning approaches for optimizing hybrid renewable energy systems in decentralized smart grids to improve both energy efficiency and grid stability. Ahamed et al. [43] proposed a sentiment recognition method that integrates bidirectional deep learning with an extended fuzzy Markov model. Hossain et al. [44] explored the application of explainable AI to business decision-making as a way to address trust-related concerns. In industrial inspection, Haque et al. [45] introduced a data-centric leather quality control framework using advanced vision transformer models.

5.3 Healthcare: privacy-first learning and low-latency clinical decision support

Healthcare dominates the corpus with titles on breast cancer diagnosis [16], [19], early detection frameworks [26], cervical cancer screening [65], lung cancer detection [49], brain tumour classification and segmentation [22], [23], [60], [63], [64], leukemia diagnostics [61], [73], eye disease classification [29], skin cancer diagnosis [30], EMG signal analysis [35], [37], [38], CKD screening [27], mortality risk prediction [28], mental health indicator identification [50], and early leukemia diagnostics [61]. Privacy-first federated learning [13], [18], [48], scalable FL strategies for healthcare [27], and edge intelligence for critical diseases [15] highlight the need for distributed learning. Low-latency edge inference is crucial for time-sensitive decisions [15], while hybrid and decentralized transformer models [63], [64] demonstrate partitioned processing. Governance in healthcare involves accountability and compliance with privacy laws; welfare governance models [5] and inclusive development initiatives [56] emphasise fairness and transparency.

5.4 Digital finance/business analytics

Finance and business analytics titles include credit card fraud detection [40], AI-driven risk management and fraud prevention [57], AI-driven business analytics [2], strategic business gains in healthcare [47], impact of IT product innovation [53], small business empowerment [55], future of AI-powered SaaS [52], and digital security for deepfake detection [54]. Fraud detection pipelines rely on machine and deep learning models, often deployed in cloud environments. Privacy and security are paramount due to financial data sensitivity; federated and encrypted learning may be applied to prevent data leakage. Governance includes compliance with financial regulations and auditability of decisions.

5.5 Public sector/welfare management and policy compliance

Titles on data-centric governance models [5], MIS solutions for national energy dominance [3], project governance and stakeholder collaboration [7], inclusive economic development and AI bridging socioeconomic divides [56], empowering small businesses [55], welfare management and bias control [5], and policy compliance via explainable AI [44] illustrate the importance of transparency and auditability. Distributed intelligence may support welfare eligibility determination, policy compliance, and public resource allocation while preserving citizens' privacy. Governance models must ensure fairness, explainability and accountability, leveraging MIS and blockchain audit trails [11].

6 Assurance and Evaluation for Real-World Deployment

Deploying distributed AI systems responsibly requires evaluating both system-level and model-level metrics. System metrics include latency, throughput, energy consumption, availability and failure recovery. Edge and 6G deployments [8], [15], [24] must meet stringent latency requirements, while hybrid and cloud architectures [2], [7] must ensure high availability and scalability. Model metrics encompass calibration (e.g., Brier score), robustness under adversarial and distributional shifts [1], fairness diagnostics [27], and drift detection. Privacy and security evaluation demands red-team exercises to simulate membership inference, model inversion, poisoning and gradient leakage attacks [13], [59]; privacy accounting to quantify leakage in differential privacy and secure aggregation [18]; and poisoning tests to assess resilience in FL and edge pipelines [25], [33]. Explainability in distributed settings requires stability of explanations across edge and cloud models and stakeholder-facing explanations that align with domain knowledge [14], [50], [69]. Monitoring and incident response involve logging predictions, inputs and model versions [5], [11], [54], triggering alerts for anomalous behaviour, enabling rollback to prior models and ensuring human oversight. An assurance checklist synthesises these considerations for practitioners.

7 Cross-Cutting Design Patterns and Reference Architectures

Recurring design patterns emerge from the portfolio. A privacy-by-design FL pattern trains models locally with secure aggregation, differential privacy and threat modeling; this suits healthcare diagnostics [13], [18], [48] and financial fraud detection [57]. An edge triage + cloud adjudication pattern performs preliminary inference at the edge to triage cases (e.g., medical images [15], plant disease detection [66]) and escalates uncertain cases to cloud-based experts for adjudication. A secure telemetry + audit log pattern collects and encrypts sensor data, transmits to cloud MIS and stores decisions and model versions on an immutable ledger [11], [54], [5]. A zero-touch model lifecycle pattern leverages 6G autonomic management [8] to automate deployment, monitoring and updates of AI models across edge and cloud. Finally, the literature reflects the growing reach of AI across healthcare, business systems, and digital product markets. Khan et al. [49] presented generalizable ensemble learning models for early lung cancer detection, whereas Shakil et al. [31] performed a comparative analysis of deep learning architectures for chest disease and lymphoma classification. Outside core clinical prediction, Mosaddeque et al. [46] investigated how AI and quantum computing could streamline supply chains in aerospace and education, and Sufian et al. [47] considered the strategic advantages of machine learning in the healthcare business sector. Ahmed et al. [52] further examined market trajectories and investment opportunities in AI-powered SaaS, highlighting the rising economic importance of intelligent software platforms.

8 Research Agenda

8.1 Standardised threat modeling for federated learning in critical sectors

Motivation: Current titles highlight federated learning adoption [13], [18], [48] but lack systematic threat modeling.

What to measure: Catalogue attack types (inference, inversion, poisoning); measure vulnerability; define threat profiles per sector.

Recommended protocol: Develop threat libraries and simulation environments; apply to healthcare, energy and finance case studies; evaluate mitigation efficacy.

Expected impact: Enables stakeholders to anticipate and counter threats, improving FL adoption and safety.

8.2 Joint optimisation of privacy, utility, latency and energy

Motivation: Distributed deployments must balance accuracy, privacy, latency and energy consumption [8], [15], [24].

What to measure: Define multi-objective metrics combining differential privacy budgets, inference latency and energy usage.

Recommended protocol: Benchmark models on edge devices and cloud; evaluate trade-offs across privacy mechanisms and compression schemes.

Expected impact: Guides practitioners in selecting models and deployment strategies that meet operational constraints.

8.3 Explainability for distributed pipelines and end-to-end accountability

Motivation: Titles suggest explainable AI [14], [23], [60], [69] but integration into distributed pipelines is unclear.

What to measure: Assess explanation fidelity and stability across edge and cloud components; measure user trust and decision impact.

Recommended protocol: Design experiments comparing explanations generated at edge vs cloud; conduct user studies in healthcare and finance.

Expected impact: Ensures explanations remain coherent and trustworthy, supporting decision making across distributed deployments.

8.4 Governance automation: policy-as-code for AI pipelines

Motivation: Governance controls must adapt to changing policies and data regulations [5], [7], [54], [56].

What to measure: Define compliance metrics; evaluate policy enforcement latency and auditability.

Recommended protocol: Develop policy-as-code frameworks integrated with MIS; test enforcement in federated and edge deployments; monitor compliance.

Expected impact: Automated governance reduces human error, increases transparency and accelerates regulatory approval.

8.5 Continual learning under compliance constraints

Motivation: Models must adapt to new data while respecting privacy and fairness; titles suggest evolving domains such as renewable energy [10], [33] and healthcare diagnostics [14].

What to measure: Quantify forgetting, fairness shift and privacy leakage during incremental updates.

Recommended protocol: Design continual learning frameworks with differential privacy and fairness constraints; evaluate on healthcare and energy datasets.

Expected impact: Enables adaptive AI systems that remain compliant and fair over time.

Limitations

This review is limited by its reliance on titles only; specific datasets, methods, numerical results and contextual details remain unknown. Inferences about deployment archetypes, privacy emphasis and security threats may misrepresent the underlying studies. The classification of modalities, tasks and governance implications is based on general domain knowledge and may require revision when full texts are consulted.

9 Conclusion

Distributed intelligence across edge, cloud, 6G and federated learning is becoming the default for secure, privacy-preserving decision support. This title-driven scoping review organised publications into a deployment taxonomy, mapped threat models and mitigation strategies, and synthesised sector-specific needs across critical infrastructure, energy, healthcare, finance and public welfare. It highlighted the importance of governance and auditability and proposed research directions addressing threat modeling, privacy-utility-latency trade-offs, end-to-end explainability, policy-as-code and continual learning. The findings serve as a conceptual framework for practitioners and researchers to advance trustworthy distributed AI, pending comprehensive evidence from full texts.

Compliance with ethical standards

Disclosure of conflict of interest

There is no conflict of interest.

References

- [1] Goffer MA, Uddin MS, Hasan SN, Barikdar CR, Hassan J, Das N, Chakraborty P, Hasan R. Ai-enhanced cyber threat detection and response advancing national security in critical infrastructure. *Journal of Posthumanism*. 2025 Apr 17;5(3):1667-89.
- [2] Haldar U, Alam GT, Rahman H, Miah MA, Chakraborty P, Saimon AS, Chy MA, Siddiqa KB, Manik MM. AI-driven business analytics for economic growth leveraging machine learning and MIS for data-driven decision-making in the US economy. *Journal of Posthumanism*. 2025 Apr 24;5(4):932-57.
- [3] Hassan J, Rahman H, Haldar U, Sultana S, Rahman MM, Chakraborty P, Das N, Barikdar CR. Implementing MIS solutions to support the national energy dominance strategy. *Journal of Posthumanism*. 2025 May 20;5(5):4343-63.
- [4] Mahmud F, Goffer MA, Chakraborty P, Sultana S, Rozario E, Miah MA, Chy MA, Haldar U. AI-powered workforce analytics forecasting labor market trends and skill gaps for US economic competitiveness. *Journal of Computer Science and Technology Studies*. 2024 Dec 31;6(5):265-77.
- [5] Uddandarao DP, Valiveti SS, Varanasi SR, Rahman H, Chakraborty P. Data-Centric Governance Models Using Trustworthy AI: Strengthening Transparency, Bias Control, and Policy Compliance in Welfare Management. *International Journal on Engineering Artificial Intelligence Management, Decision Support, and Policies*. 2025;2(4):29-44.
- [6] Chakraborty P, Siddiqa KB, Rahman H, Miah MA, Das N, Goffer MA, Das S. Leveraging artificial intelligence and machine learning for decision-making in business management: A comprehensive analysis. *Journal of Management World*. 2025:46-56.
- [7] Mahmud F, Goffer MA, Rahman H, Chakraborty P, Das N, Orthi SM, Alam GT. The Role of Cloud-Based Management Information Systems in Enhancing IT Project Governance and Stakeholder Collaboration. In *International Conference on AI and Robotics 2025* May 9 (pp. 1-14).
- [8] Mahin MR, Chakraborty P, Das N, Kaur H, Himel HU, Kaur J, Mohapatra AG. Secured and Standardized Intelligent Zero-Touch 6G Framework for Edge-AI Applications. *IEEE Communications Standards Magazine*. 2026 Feb 25.
- [9] Orthi SM, Chakraborty P, Siam MA, Shan-A-Alahi A, Al Zaiem A, Hasan SN, Kaur J, Mahmud F, Goffer MA. AI-Driven Cyber Threat Intelligence as a Management Information System: Integrating Cybersecurity Governance and IT Project Management for Organizational Resilience. *The Eastasouth Journal of Information System and Computer Science*. 2023 Dec 30;1(02):194-213.
- [10] Ahmed I, Khan MA, Islam MD, Hasan MS, Jakir T, Hossain A, Abed J, Hasanuzzaman M, Shaty SS, Hasnain KN. Optimizing Solar Energy Production in the USA: Time-Series Analysis Using AI for Smart Energy Management. *arXiv preprint arXiv:2506.23368*. 2025 Jun 29.
- [11] Khan MA, Islam MD, Ahmed I, Rabbi MM, Anonna FR, Zeeshan MD, Ridoy MH, Chowdhury BR, Rabbi MN, Sadnan GM. Secure Energy Transactions Using Blockchain Leveraging AI for Fraud Detection and Energy Market Stability. *arXiv preprint arXiv:2506.19870*. 2025 Jun 21.

- [12] Ahmed I, Khan MA, Islam MA, Ahamed A, Siam MA, Islam MZ. Utilizing ai to enhance renewable energy generation and advanced storage technologies for smart energy solutions. In2025 International Conference on Metaverse and Current Trends in Computing (ICMCTC) 2025 Apr 10 (pp. 1-10).
- [13] Ahmed I. Privacy-Preserving Federated Learning for Critical Infrastructure: A Systematic Review of Security Threat Models, Deployment Patterns, And Governance. International Journal of Scientific Interdisciplinary Research. 2026 Feb 13;7(1):204-35.
- [14] Siam MA, Ahmed I, Khan MA, Islam MA, Milon MH, Ahamed A, Islam MZ. Explainable Deep Learning Models for Medical Diagnosis: Bridging the Gap between AI and Healthcare. In2025 3rd International Conference on Business Analytics for Technology and Security (ICBATS) 2025 May 1 (pp. 1-7).
- [15] Islam MZ, Ahmed I, Parveen R, Rimon ST, Janjua JI. Revolutionizing Healthcare for Critical Diseases with AI and Enhancing Security via Low-Latency Edge Intelligence. In2025 International Conference on AI-Driven STEM Education and Learning Technologies (AISTEMEDU) 2025 Dec 1 (pp. 1-6).
- [16] Khan MA, Parveen R, Ahmed I, Milon MH, Khan TA. High-Accuracy Breast Cancer Diagnosis Using Neural Networks and Dimensionality Reduction Techniques. In2025 IEEE 19th International Conference on Open Source Systems and Technologies (ICOSST) 2025 Dec 1 (pp. 1-6).
- [17] Khan MA, Papel MS, Milon MH, Ahmed I, Islam MZ, Raja MR. Optimizing Stroke Prediction in Healthcare with Neural Machine Learning Algorithms. In2025 3rd International Conference on Cyber Resilience (ICCR) 2025 Jul 3 (pp. 1-7).
- [18] Ahmed I, Papel MS, Raja MR, Islam MZ, Khan MA, Milon MH. Privacy-First Federated Learning Models for Scalable Healthcare Data Processing. In2025 3rd International Conference on Cyber Resilience (ICCR) 2025 Jul 3 (pp. 1-6).
- [19] Raja MR, Milon MH, Ahmed I, Papel MS, Khan MA, Islam MZ. Optimizing Neural Architectures for Accurate Diagnosis of Breast Cancer from Morphological Features. In2025 3rd International Conference on Cyber Resilience (ICCR) 2025 Jul 3 (pp. 1-6).
- [20] Milon MH, Rahman MM, Papel MS, Raja MR, Semi MM, Tarafder MT. Digital Twin Technology for Predictive Maintenance in Industrial Iot Environments: Enhancing Operational Efficiency and Asset Longevity. In2025 3rd International Conference on Business Analytics for Technology and Security (ICBATS) 2025 May 1 (pp. 1-8).
- [21] Islam MZ, Siam MA, Ahmed I, Khan MA, Islam MA, Milon MH. Fortifying Healthcare and Essential Infrastructure with AI-Driven Cybersecurity Technologies. In2025 International Conference on Metaverse and Current Trends in Computing (ICMCTC) 2025 Apr 10 (pp. 1-9).
- [22] Oza BA, Khan IR, Kanulla NS, Hasan SM, Davuluri SK, Pothakamuri LN. Artificial Intelligence based Ensemble Learning Approach for Brain Tumour Classification Using MRI Images. In2024 7th International Conference on Contemporary Computing and Informatics (IC3I) 2024 Sep 18 (Vol. 7, pp. 1583-1588).
- [23] Khushubu KG, Al Masum A, Rahman MH, Hasan SM, Bhuiyan MI, Mahmud MR, Swapno SM, Appaji A. Transunetb: An advanced transformer–unet framework for efficient and explainable brain tumor segmentation. Informatics in Medicine Unlocked. 2025 Nov 1:101706.
- [24] Hasan SM, Gudala L, Soni M, Quraishi A, Keshta I, Reegu FA. Deep Reinforcement Learning-Based Real-time Data Analytics of Automatic Industrial Robot for High Speed Communication. In2024 IEEE 2nd International Conference on Innovations in High Speed Communication and Signal Processing (IHCSP) 2024 Dec 6 (pp. 1-8).
- [25] Hasan SM, Keshta I, Thakkar D, Gudala L, Soni M, Maaliw RR. Deep Learning-Based Intrusion Detection Model for Internet of Things Environment. In2024 IEEE 2nd International Conference on Innovations in High Speed Communication and Signal Processing (IHCSP) 2024 Dec 6 (pp. 1-8).
- [26] Arafat Y, Asha NB, Ahmed S, Sakib SH, Shakil MR, RISHTA AZ, Rahat SR. A Deep Learning Framework for Early Breast Cancer Detection Among US Women: Integrating Mammography and Clinical EHR Data. British Journal of Nursing Studies. 2025 Dec 17;5(3):44-59.
- [27] Rimon ST, Hasan E, Asha NB, Sultana R, Sharmin F, Rahaman M, Shakil MR. A Scalable Machine Learning Strategy for Chronic Kidney Disease Screening Across US Healthcare Systems. Frontiers in Computer Science and Artificial Intelligence. 2026 Jan 28;5(1):40-54.
- [28] Hasan E, Asha NB, Rahaman M, Shakil MR, Haque MM, Paul D, Al Amin M. An Explainable Machine Learning Framework for Mortality Risk Prediction of Liver Cirrhosis Patients in the US Healthcare System. Frontiers in Computer Science and Artificial Intelligence. 2026 Feb 22;5(4):15-26.

- [29] Asha NB, Shakil MR, Rahat SR, Sakib SH, Rahaman M, Hasan E, Ahmed S. A Transfer Learning–Based Deep Convolutional Neural Network Framework for Automated Multi-Class Eye Disease Classification in the USA Using Retinal Fundus Image. *Journal of Medical and Health Studies*. 2023 Jul 23;4(4):209-17.
- [30] Rahat SR, Rahaman M, Sakib SH, Ahmed S, Asha NB, Shakil MR, Hasan E. Deep Learning–Based Skin Cancer Diagnosis in the United States: Advances, Challenges, and Clinical Translation. *Journal of Medical and Health Studies*. 2023 Dec 25;4(6):150-60.
- [31] Shakil MR, Hasan M, Tarek MIH, Polash FI, Meem EJ. Performance analysis of deep learning architectures for chest disease and lymphoma classification. *World Journal of Advanced Engineering Technology and Sciences*. 2025 Oct 31;17(1):233–47.
- [32] Hasan MS, Tarequzzaman M, Moznuzzaman M, Juel MA. Prediction of energy consumption in four sectors using support vector regression optimized with genetic algorithm. *Heliyon*. 2025 Jan 30;11(2).
- [33] Juel MA, Uddin N, Abid MA, Islam MZ, Nasim AA, Sourov S, Jaman MS. Machine Learning Approached for Sophisticated Relay to Mitigate Blackouts in Power System. In 2025 15th International Conference on Power, Energy, and Electrical Engineering (CPEEE) 2025 Feb 15 (pp. 231-235).
- [34] Tonny FE, Rahman M, Kajal MK, Juel MA, Hassan M. Data-driven Resilient Grid Operation Under Growing EV Penetration. In 2025 International Conference on Electrical, Computer and Communication Engineering (ECCE) 2025 Feb 13 (pp. 1-6).
- [35] Tanbhir R, Juel MA, Abdullah A, Moznuzzaman M. Performance study of dwt and emd techniques for denoising electromyographic signal. In 2025 International Conference on Electrical, Computer and Communication Engineering (ECCE) 2025 Feb 13 (pp. 1-6).
- [36] Khan MN, Juel MA, Nasim AA, Islam MZ, Jamil MS, Jaman MS, Robbani MS. Influence of Inductance and Skin Effect in Multi-layer Coaxial Cables on Transient Wave Propagation in Transformer Bushings. In 2025 Interdisciplinary Conference on Electrics and Computer (INTCEC) 2025 Sep 15 (pp. 1-6).
- [37] Mondal R, Bose D, Juel MA, Tarequzzaman M, Moznuzzaman DM. Efficient EMG Signal Classification Using Domain-Optimized Features. In 2025 International Conference on Quantum Photonics, Artificial Intelligence, and Networking (QPAIN) 2025 Jul 31 (pp. 1-6).
- [38] Datta TC, Tanbhir R, Juel MA, Islam M, Moznuzzaman M. Advancing Electromyography Signal Analysis: Wavelet-Based Filtering for Low Back Pain Patients Assessment. In 2025 2nd International Conference on Next-Generation Computing, IoT and Machine Learning (NCIM) 2025 Jun 27 (pp. 1-6).
- [39] Pasha SM, Ye C, Sumon MS, Jaman MS, Sohag SR, Ali MM, Juel MA. Generalized and Robust LSTM Model for Fault Detection and Classification in Power Transmission Line. In 2025 7th Asia Energy and Electrical Engineering Symposium (AEEES) 2025 Mar 28 (pp. 422-426).
- [40] Juel MA, Islam M, Jahan SN, Tarek A, Al Hasib A, Jaman MS. Evaluating Machine Learning and Deep Learning Models for Credit Card Fraud Detection in Cybersecurity. In 2025 10th International Conference on Information and Network Technologies (ICINT) 2025 Mar 12 (pp. 142-146).
- [41] Ahmed H, Tanbhir R, Shohag JA, Islam MM, Juel AA, Moznuzzaman M. Evaluation of the Importance of Shoulder Strength, Hand strength and Heart Rate Recovery for Badminton Players. In 2025 International Conference on Electrical, Computer and Communication Engineering (ECCE) 2025 Feb 13 (pp. 1-5).
- [42] Ahamed A, Fardin H, Hasan E, Rimon ST, Haque MM. A Review of Machine Learning Approaches for Optimizing Hybrid Renewable Energy Systems (HRES) in Decentralized Smart Grids: Enhancing Energy Efficiency and Grid Stability. *Iranian Journal of Science and Technology, Transactions of Electrical Engineering*. 2025 Oct 23:1-4.
- [43] Ahamed A, Tarafder MT, Rimon ST, Ahmed N. Bidirectional deep learning and extended fuzzy Markov model for sentiments recognition. *ICCK Transactions on Neural Computing*. 2025 Mar 30;1(1):11-29.
- [44] Hossain Z, Hossain IS, Kabir MF, Rahman A, Gharami AK, Sumi SS, Ahamed A. Implementing Explainable AI to Enhance Business Decision Making & Bridging the Trust Gap. In 2025 International Conference on Artificial Intelligence in Information and Communication (ICAIIIC) 2025 Feb 18 (pp. 0072-0077).
- [45] Haque R, Khan M, Pranto MN, Islam MA, Islam MB, Rawat U, Bhattacharya P, Jangid M. Data-Centric Approach for Leather Quality Control Using Advanced Vision Transformer Models. In 2025 International Conference on Next Generation Communication & Information Processing (INCIP) 2025 Jan 23 (pp. 200-205).

- [46] Mosaddeque AI, Guria ZM, Morshed N, Sufian MA, Ahamed A, Rimon ST. Transforming AI and Quantum Computing to Streamline Business Supply Chains in Aerospace and Education. In 2024 International Conference on TVET Excellence & Development (ICTeD) 2024 Dec 16 (pp. 231-236).
- [47] Sufian MA, Rimon ST, Mosaddeque AI, Guria ZM, Morshed N, Ahamed A. Leveraging Machine Learning for Strategic Business Gains in the Healthcare Sector. In 2024 International Conference on TVET Excellence & Development (ICTeD) 2024 Dec 16 (pp. 225-230).
- [48] Fakrul Islam Polash M, Khan S, Imam M, Tarek H, Hasan M, Shakil R, et al. Automated white blood cell diagnostics using federated learning and distributed deep learning. *World Journal of Advanced Engineering Technology and Sciences*. 2025 Oct 31;17(1):218-32.
- [49] Khan S, Hasan M, Tarek MIH, Shakil MR, Polash MF islam, Kabir I. Generalizable Ensemble Learning Models for Early Lung Cancer Detection. *World Journal of Advanced Engineering Technology and Sciences*. 2025 Oct 31;17(1):200-17.
- [50] Meem EJ, Fakrul Islam Polash M, Imam M, Tarek H, Hasan M, Shakil MR. Identifying Critical Mental Health Indicators Using Ensemble and Explainable AI Techniques. *World Journal of Advanced Engineering Technology and Sciences*. 2025 Oct 31;17(1):186-99.
- [51] ZakirHossain M, Khan MM, Thapa S, Uddin R, Meem EJ, Niloy SK, Rafi MA, Shazib MS, Kabir MF, Bhavani GD. Advanced deep learning techniques for precision diagnosis of tea leaf diseases. In 2025 IEEE International Conference on Emerging Technologies and Applications (MPSec ICETA) 2025 Feb 21 (pp. 1-6).
- [52] Ahmed KR, Ahmmed MR, Kowser S, Faruq O, Shammah RS, Sufian MA. The Future of AI-Powered SaaS: Market Trends and Investment Opportunities. In 2025 International Conference on Quantum Photonics, Artificial Intelligence, and Networking (QPAIN) 2025 Jul 31 (pp. 1-6).
- [53] Ahmed KR, Sufian MA, Faruq O, Kowser S, Shammah RS, Ahmmed MR. Impact of IT Product Innovation on Competitive Advantage in the Digital Economy. In 2025 International Conference on Quantum Photonics, Artificial Intelligence, and Networking (QPAIN) 2025 Jul 31 (pp. 1-6).
- [54] Ahmed KR, Shammah RS, Kowser S, Faruq O, Sufian MA, Ahmmed MR. Strengthening Digital Security in MIS: A Business Analytics Approach to Deepfake Detection. In 2025 International Conference on Quantum Photonics, Artificial Intelligence, and Networking (QPAIN) 2025 Jul 31 (pp. 1-6).
- [55] Sufian MA, Morshed N, Rahman I, Guria ZM, Dhar SR. Empowering Small Businesses with Digital Innovation by Leveraging IT Infrastructure, Data Analytics, and AI for Sustained Growth. In 2025 International Conference on Artificial Intelligence's Future Implementations (ICAIFI) 2025 Sep 14 (pp. 94-99).
- [56] Guria ZM, Morshed N, Rahman I, Dhar SR, Sufian MA. Advancing Global Peace through Inclusive Economic Development and the Role of Artificial Intelligence in Bridging Socioeconomic Divides. In 2025 International Conference on Artificial Intelligence's Future Implementations (ICAIFI) 2025 Sep 14 (pp. 100-105).
- [57] Guria ZM, Rahman I, Kowser S, Morshed N, Shammah RS, Faruq O. AI-Driven Risk Management and Fraud Prevention in Digital Finance as a Catalyst for US Economic Resilience and Global Financial Leadership. In 2025 IEEE 19th International Conference on Open Source Systems and Technologies (ICOSST) 2025 Dec 1 (pp. 1-8).
- [58] Haque R, Islam N, Tasneem M, Das AK. Multi-class sentiment classification on Bengali social media comments using machine learning. *International journal of cognitive computing in engineering*. 2023 Jun 1;4:21-35.
- [59] Haque R, Islam N, Islam M, Ahsan MM. A comparative analysis on suicidal ideation detection using NLP, machine, and deep learning. *Technologies*. 2022 Apr 29;10(3):57.
- [60] Haque R, Khan MA, Rahman H, Khan S, Siddiqui MI, Limon ZH, Swapno SM, Appaji A. Explainable deep stacking ensemble model for accurate and transparent brain tumor diagnosis. *Computers in Biology and Medicine*. 2025 Jun 1;191:110166.
- [61] Haque R, Laskar SH, Khushbu KG, Hasan MJ, Uddin J. Data-driven solution to identify sentiments from online drug reviews. *Computers*. 2023 Apr 21;12(4):87.
- [62] Ahmed MR, Rahman H, Limon ZH, Siddiqui MI, Khan MA, Pranta AS, Haque R, Swapno SM, Cho YI, Abdallah MS. Hierarchical swin transformer ensemble with explainable ai for robust and decentralized breast cancer diagnosis. *Bioengineering*. 2025 Jun 13;12(6):651.

- [63] Debnath J, Hossain A, Sakib A, Rahman H, Haque R, Ahmed MR, Reza AW, Swapno SM, Appaji A. LMVT: A hybrid vision transformer with attention mechanisms for efficient and explainable lung cancer diagnosis. *Informatics in Medicine Unlocked*. 2025 Jul 9;101669.
- [64] Siddiqui MI, Khan S, Limon ZH, Rahman H, Khan MA, Al Sakib A, Swapno SM, Haque R, Reza AW, Appaji A. Accelerated and accurate cervical cancer diagnosis using a novel stacking ensemble method with explainable AI. *Informatics in Medicine Unlocked*. 2025 Jan 1;56:101657.
- [65] Pranta AS, Fardin H, Debnath J, Hossain A, Sakib AH, Ahmed MR, Haque R, Reza AW, Dewan MA. A novel maxvit model for accelerated and precise soybean leaf and seed disease identification. *Computers*. 2025 May 18;14(5):197.
- [66] Noman AA, Hossain A, Sakib A, Debnath J, Fardin H, Sakib AA, Haque R, Ahmed MR, Reza AW, Dewan MA. ViX-MangoEFormer: An Enhanced Vision Transformer-EfficientFormer and Stacking Ensemble Approach for Mango Leaf Disease Recognition with Explainable Artificial Intelligence. *Computers*. 2025 May 2;14(5):171.
- [67] Ahmed MR, Haque R, Rahman SMA, Reza AW, Siddique N, Wang H. Vision-audio multimodal object recognition using hybrid and tensor fusion techniques. *Information Fusion*. 2026 Feb 1;126:103667.
- [68] Islam S, Haque R, Khan MA, Mohiuddin AB, Siddiqui MI, Limon ZH, Khushbu KG, Swapno SM, Ahmed MR, Appaji A. Ensemble transformer with post-hoc explanations for depression emotion and severity detection. *iScience*. 2026 Feb 20;29(2).
- [69] Swapno SM, Sakib A, Hossain A, Debnath J, Al Noman A, Al Sakib A, Ahmed MR, Haque R, Appaji A. Explainable transformer framework for fast cotton leaf diagnostics and fabric defect detection. *IScience*. 2026 Feb 20;29(2).
- [70] Khan S, Rahman H, Siddiqui MI, Limon ZH, Khan MA, Haque R, Ahmed MR, Reza AW, Ripon SH. Ensemble-Based Explainable Approach for Rare Medicinal Plant Recognition and Conservation. In 2025 10th International Conference on Information and Network Technologies (ICINT) 2025 Mar 12 (pp. 88-93).
- [71] Rahman MM, Hossain MS, Dhakal K, Poudel R, Islam MM, Ahmed MR, Rahman S. A Novel Transformer Model for Accelerated and Efficient Cotton Leaf Disease Identification. In 2025 International Conference on Quantum Photonics, Artificial Intelligence, and Networking (QPAIN) 2025 Jul 31 (pp. 1-6).
- [72] Hasan J, Hasan K, Al Noman A, Hasan S, Sultana S, Arafat MA, Islam SA, Sarker A, Rahman S, Ahmed MR. Transforming leukemia classification: A comprehensive study on deep learning models for enhanced diagnostic accuracy. In 2024 IEEE International Conference on Power, Electrical, Electronics and Industrial Applications (PEEIACON) 2024 Sep 12 (pp. 1-6).
- [73] Haque R, Sultana S, Rafy A, Islam MB, Arafat MA, Bhattacharya P, et al. A transfer learning-based computer-aided lung cancer detection system in smart healthcare. *IET Conference Proceedings*. 2025 Mar;2024(37):594–601.
- [74] Mohiuddin AB, Rahman MM, Gony MN, Shuvra SM, Rafy A, Ahmed MR, Rahman S. Accelerated and Accurate Cervical Cancer Diagnosis Using a Novel Stacking Ensemble Method with Explainable AI. In 2025 International Conference on Quantum Photonics, Artificial Intelligence, and Networking (QPAIN) 2025 Jul 31 (pp. 1-6).
- [75] Malik AH, Rahman S. Toward precision wound healing: Integrating regenerative therapies and smart technologies. *International Journal of Science and Research Archive*. 2025 Sep 30;16(3):244–57.
- [76] Malik AH, Rahman S. Hybrid Temozolomide Nanoconjugates: A polymer–drug strategy for enhanced stability and glioblastoma therapy. *International Journal of Science and Research Archive*. 2025 Sep 30;16(3):258–68.
- [77] Malik AH, Rahman S. Molecular erasers: Reprogramming cancer immunity through protein degradation. *World Journal of Advanced Engineering Technology and Sciences*. 2025 Sep 30;16(3):277–91.
- [78] Sultana S, Rahman MM, Hossain MS, Gony MdN, Rafy A. AI-powered threat detection in modern cybersecurity systems: Enhancing real-time response in enterprise environments. *World Journal of Advanced Engineering Technology and Sciences*. 2022 Aug 30;6(2):136–46.
- [79] Abid SM, Xiaoping Q, Islam MM, Islam MA, Rahman MM, Alam ARM. Edge-Conditioned GAT for Journal Ranking in Citation Networks. 2025 IEEE 6th International Seminar on Artificial Intelligence, Networking and Information Technology, AINIT 2025. 2025;1612–9.