

Editorial: Message from the Managing Editor

Exploring cutting-edge research, applications, and future directions in artificial intelligence across diverse domains

Tole Sutikno^{1,2}

¹Faculty of Industrial Technology, Universitas Ahmad Dahlan, Yogyakarta, Indonesia

²Embedded System and Power Electronics Research Group, Yogyakarta, Indonesia

Article Info

Keywords:

Artificial intelligence
Deep learning
Explainable AI
Intelligent systems
Internet of things
Machine learning applications
Predictive analytics

ABSTRACT

This issue highlights the most recent advances in artificial intelligence (AI) research, which cover a wide range of applications, methodologies, and emerging technologies. The gathered works highlight AI's transformative potential in a variety of fields, including healthcare, environmental monitoring, energy systems, intelligent transportation, cybersecurity, smart agriculture, and human-computer interactions. The featured studies demonstrate novel applications of deep learning, convolutional neural networks, vision transformers, reinforcement learning, ensemble methods, and explainable AI techniques, with a focus on both performance optimisation and interpretability. The issue also delves into AI integration with IoT, blockchain, big data, and mobile platforms, showcasing scalable and real-time solutions for dynamic, data-intensive settings. Aside from technical accomplishments, the contributions address practical issues such as model generalisation, feature selection, data quality, privacy, and ethical concerns. These works show how AI is improving decision-making, predictive capabilities, and operational efficiency while addressing complex societal and industrial issues. Looking ahead, this issue encourages reflection on AI development trajectories, emphasising the importance of robust, explainable, and adaptive systems that balance computational power and interpretability. This issue aims to inform, inspire, and guide practitioners and researchers in shaping the next generation of intelligent technologies by providing a comprehensive overview of cutting-edge AI research and real-world applications.

This is an open access article under the [CC BY-SA](#) license.



Corresponding Author:

Tole Sutikno

Master Program of Electrical Engineering, Faculty of Industrial Technology, Universitas Ahmad Dahlan
UAD 4th Campus, South Ring Road, Tamanan, Banguntapan, Bantul, Yogyakarta 55166, Indonesia

Email: tole@te.uad.ac.id

Introduction: The Transformative Potential of Artificial Intelligence

Artificial intelligence (AI) has emerged as one of the most transformative forces in modern science, technology, and industry. From healthcare and environmental monitoring to transportation, agriculture, cybersecurity, and education, AI is redefining what is possible, enabling previously unthinkable innovations. This issue delves into a wide range of cutting-edge research, practical applications, and future directions in AI across multiple domains, emphasising both the breadth and depth of ongoing progress. By highlighting these developments, we hope to inspire, inform, and provide a road map for researchers,

practitioners, and policymakers involved in AI innovation, while also drawing attention to the broader societal, economic, and ethical considerations that come with the deployment of AI technologies.

AI is no longer limited to isolated applications or theoretical models; it has become deeply integrated into society's digital infrastructure, influencing decision-making, operational efficiency, and human-computer interaction. AI systems are becoming increasingly capable of solving highly complex problems in real time, often outperforming traditional approaches, thanks to advances in computational power, the availability of massive datasets, and the maturation of machine learning, deep learning, and reinforcement learning methodologies. These capabilities encompass structured and unstructured data, multi-modal inputs, and dynamic environments, resulting in unprecedented opportunities for scientific discovery, industrial optimisation, predictive modelling, and social impact. Furthermore, AI enables adaptive and context-aware systems that continuously learn from evolving data streams, self-optimize, and generate actionable insights at previously unimaginable scales and speeds, empowering industries and societies to address pressing global challenges, increase human productivity, and transform how we interact with the digital and physical worlds.

AI in Healthcare: From Diagnostics to Personalized Care

Healthcare remains one of the most significant domains for AI applications. The combination of machine learning, deep learning, and explainable AI has transformed diagnostics, predictive modelling, and personalised patient care. Modern AI systems can analyse complex biomedical data, medical images, and electronic health records (EHRs) to detect subtle patterns and correlations that human experts may miss, resulting in earlier, more accurate, and potentially lifesaving diagnoses. These capabilities not only improve clinical outcomes, but also help to optimise workflow efficiency, reduce human error, and prioritise resources in increasingly complex healthcare environments.

For example, applying convolutional neural networks (CNNs) to colposcopy images allows for automated early detection of cervical cancer, increasing screening efficiency while reducing reliance on specialist availability. Similarly, hybrid AI models that combine ensemble learning and Shapley additive explanations (SHAP) improve cardiovascular risk prediction in heart failure patients, balancing high predictive accuracy with interpretability, which is critical for clinical adoption. Such explainable models help clinicians understand and trust AI-generated recommendations, allowing them to make informed decisions while maintaining accountability and patient safety. Other applications include AI-driven brain tumour segmentation and classification, which combines deep learning with advanced optimisation algorithms to aid in precise treatment planning and prognosis.

Beyond diagnostics, AI enables continuous patient monitoring, predictive analytics, and personalised treatment planning. Real-time monitoring of physiological signals, such as electrodermal activity (EDA) and heart rate variability (HRV), allows for precise assessment of mental workload, stress levels, and cognitive state, especially in demanding situations like esports performance, rehabilitation programs, or mental health interventions. AI integration with wearable sensors and Internet of Things (IoT) devices enables seamless, non-intrusive patient observation, allowing for timely interventions, adaptive therapy, and dynamic risk management, all of which can reduce hospital readmissions and improve long-term patient outcomes.

AI's potential in healthcare is expanded further by natural language processing (NLP) and retrieval-augmented generation frameworks. Intelligent virtual assistants and artificial intelligence-enhanced medical knowledge systems accelerate access to evidence-based information, improving clinical decision support, medical research, and patient education. When combined with real-time semantic search, vector-based embeddings, and adaptive learning techniques, these AI solutions enhance factual accuracy, contextual relevance, and usability for both healthcare professionals and patients. As a result, the healthcare ecosystem is more informed, efficient, and patient-centric, with AI augmenting clinical expertise while also empowering individuals to actively participate in their care.

Environmental Monitoring and Sustainable Development

AI is having a significant impact on environmental management and sustainable development. Accurate prediction and continuous monitoring of air quality, water quality, and ecosystem health are critical for protecting public health, conserving biodiversity, and bolstering climate adaptation strategies. Machine learning models, such as ensemble methods, boosting techniques, and hybrid approaches, offer scalable and computationally efficient solutions for processing complex, heterogeneous environmental data. AI systems can uncover hidden patterns, track temporal trends, and provide actionable insights for policymakers and environmental managers by integrating data streams from multiple sources, ranging from satellite observations to ground sensors.

Satellite imagery and remote sensing, when combined with AI algorithms, allow for precise prediction of key water quality parameters such as chlorophyll-a concentration, dissolved oxygen levels, total suspended solids, and salinity. Air pollution and indoor air quality can also be accurately forecasted using extreme gradient boosting (XGBoost), light gradient boosting machine (LGBM), and adaptive boosting (AdaBoost) models, resulting in high accuracy and timely interventions. AI models improve early warning systems for floods, earthquakes, and extreme weather events by using both synthetic and real IoT sensor data, thereby improving disaster preparedness, operational response, and community resilience over time. Furthermore, AI-driven simulations enable authorities to assess the potential impact of environmental policies, urban planning decisions, and climate adaptation strategies prior to implementation.

AI applications in agriculture have a strong correlation with sustainability goals, promoting precision farming and resource-efficient practices. Disease detection in high-value crops, such as hom-thong bananas, demonstrates how deep learning and computer vision algorithms can automatically detect infections and other stress factors in real time. Portable AI-based monitoring systems provide farmers with actionable insights to reduce crop losses, optimise irrigation and fertilisation, and improve yield quality while minimising environmental impact. These AI-enabled interventions not only increase economic value but also strengthen sustainable food systems, improve resource management, and support global agricultural competitiveness in the face of climate variability and growing population demands.

Intelligent Transportation and Smart Mobility

AI technologies are driving profound transformations in transport networks, reshaping how urban and intercity mobility is managed. Real-time traffic monitoring, adaptive routing, and predictive congestion management demonstrate AI's ability to improve mobility, reduce travel delays, and boost overall transportation safety. Advanced object detection algorithms, such as YOLOv10, enable portable, low-cost traffic monitoring systems capable of accurately estimating vehicle volume, classifying vehicle types, and calculating speed in real time, even in environments with limited infrastructure or resources. These systems facilitate data-driven urban planning and policy decisions, allowing municipalities to optimise traffic flow and prioritise infrastructure investments.

Trust-based vehicular networks and intelligent transportation systems (ITS) broaden AI's impact by combining diverse data sources, such as CCTV feeds, traffic sensors, and IoV telemetry, to optimise routing, predict congestion, and improve cybersecurity. Dynamic traffic prediction models that use ensemble learning, combined with reinforcement learning-based controllers for IoV systems, ensure seamless data transmission, low latency, and reliable connectivity in a variety of traffic densities and environmental conditions. These AI-powered solutions improve proactive traffic management, route optimisation, and anomaly detection, allowing transportation authorities to respond quickly to unexpected incidents while maintaining strong network performance.

Beyond operational optimisation, AI helps to engage and educate the public about transportation. Serious games and simulation-based platforms combine real-world traffic data with gamified experiences to help commuters, students, and urban planners understand traffic dynamics, safe driving practices, and mobility's environmental impact. These applications use predictive analytics and interactive learning to improve situational awareness while also encouraging community participation and behaviour change toward safer, smarter, and more sustainable mobility systems. Collectively, these advancements demonstrate how AI is transforming transportation networks into intelligent, adaptive, and resilient systems capable of addressing the complex challenges of contemporary urban mobility.

Security, Privacy, and Trust in AI Systems

As AI systems become more prevalent in industries and daily life, security, privacy, and trust have emerged as critical concerns. Complex infrastructures, such as industrial IoT (IIoT) networks, blockchain-enabled electronic health records (EHRs), and intelligent vehicular networks, require strong safeguards to protect sensitive data, prevent cyberattacks, and ensure continuous, dependable operation. Advanced ensemble tree-based intrusion detection systems, blockchain-integrated healthcare data management platforms, and trust-based vehicular frameworks show that AI can improve cybersecurity, enforce data integrity, and maintain high system performance even in dynamic and high-risk environments. Furthermore, these solutions can scale efficiently, making them ideal for large, heterogeneous networks requiring rapid anomaly detection and real-time decision-making.

Explainable AI (XAI) techniques, such as Shapley additive explanations (SHAP) and local interpretable model-agnostic explanations (LIME), increase model predictions' transparency, promoting accountability, user confidence, and regulatory compliance. This interpretability is especially important in high-risk domains like healthcare, finance, transportation, and public safety, where incorrect or opaque AI decisions can result in significant harm or liability. By incorporating interpretability into AI frameworks, researchers and practitioners ensure that intelligent systems are not only performant but also ethically

responsible, operationally reliable, and capable of gaining user trust. The combination of strong security architectures and transparent AI models represents a comprehensive approach to safe, reliable, and scalable AI deployment in critical sectors.

Methodological Advancements and Hybrid AI Approaches

AI methodologies are rapidly evolving, pushing the boundaries of what is possible across multiple domains. Advanced feature selection techniques, mutual information-based data exploration, ensemble learning, vision transformers, optimisation algorithms, and knowledge distillation methods all improve predictive performance while also increasing computational efficiency and model robustness. Hybrid AI systems that combine symbolic reasoning, statistical learning, and reinforcement learning are becoming more capable of adapting to dynamic environments and generalising across diverse datasets, bridging the gap between theoretical research and practical application in real-world settings.

Reinforcement learning and graph-based strategies, for example, optimise hub locations in scalable blockchain networks, lowering network latency and improving overall transaction efficiency. Hybrid neural architectures, such as selective kernel networks combined with ArcFace loss, improve human activity recognition across multi-view and multi-modal datasets, whereas sophisticated generative adversarial networks (GANs) optimised by metaheuristic algorithms allow for precise segmentation and classification of medical and satellite imagery. These innovations demonstrate modern AI's versatility, adaptability, and cross-sector applicability, emphasising its ability to tackle complex problems in healthcare, cybersecurity, smart infrastructure, and beyond, while also expanding the methodological toolkit available to researchers and practitioners.

Future Trends: The Next 5–10 Years

Looking ahead, artificial intelligence is expected to undergo significant transformations over the next five to ten years, owing to advances in computing power, data availability, and algorithmic innovation. Edge and on-device AI will be widely adopted, enabling low-latency, privacy-preserving inference in healthcare, industrial monitoring, self-driving cars, and smart cities. Real-time decision-making on devices reduces reliance on centralised cloud systems, improves system resilience, and enables applications where network connectivity is limited or intermittent. At the same time, hybrid AI systems that combine symbolic reasoning, neural networks, and reinforcement learning will become more sophisticated, providing better generalisation, interpretability, and adaptability in complex and dynamic domains ranging from precision medicine to intelligent transportation and beyond. These systems will be able to learn from sparse data, manage uncertainty, and reason across multiple modalities, bridging the gap between human-like comprehension and computational efficiency.

Ethical, legal, and societal considerations will play a critical role in shaping AI development, ensuring that transparency, accountability, fairness, and inclusivity are built into decision-making processes. Explainable AI frameworks, combined with standardised regulatory and governance protocols, will be critical in high-risk applications like healthcare, finance, and public safety. The rise of multimodal AI, which can integrate visual, textual, auditory, and sensor inputs, will allow for more holistic perception, analysis, and prediction capabilities, improving both human-computer interaction and fully automated decision making. Furthermore, AI's collaboration with emerging technologies, such as big data analytics, quantum computing, and next-generation communications like 5G and 6G, will significantly increase scalability, computational efficiency, and system resilience, accelerating intelligent solutions in industrial, environmental, and societal domains. Together, these trends point to a future in which AI not only augments human capabilities, but also becomes an indispensable, trustworthy, and ethical partner in addressing complex global issues.

Conclusion: Towards a Future of Ethical and Impactful AI

This issue features AI research from practical applications to theoretical breakthroughs and cross-disciplinary collaborations that push intelligent systems' limits. The featured studies show how technical creativity, rigorous methodology, and hybrid AI approaches can solve complex, real-world problems in healthcare, environmental management, transportation, agriculture, security, and intelligent infrastructure. To create trustworthy, inclusive, and human-valued AI systems, ethical responsibility, transparency, interpretability, and societal impact must be considered beyond performance and efficiency. Combining advanced computational techniques with fairness, accountability, and user-centric design, AI can improve quality of life, support sustainable development, and address global issues like public health crises and climate adaptation. This issue recognises the progress made and the enormous promise of AI to create safer, healthier, more equitable, and more connected societies, emphasising the need for ongoing collaboration between researchers, practitioners, and policymakers to ensure that intelligent technologies benefit humanity at large.