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Editorial Note

Intelligent innovation across disciplines: key trends from recent research in AI, IoT, and automation

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ABSTRACT

The fast growth of artificial intelligence (AI), the internet of things (IoT), and automation is changing research and business in many fields. This issue has 76 new pieces of research that show new ways to use technology and new ways to accomplish things in healthcare, communication networks, smart energy, farming, and industrial automation. Deep learning and hybrid AI models improve disease identification, medical image segmentation, and patient monitoring in healthcare, focusing on both accuracy and ease of understanding. In communication and the IoT, contributions include smart resource allocation for 5G and 6G networks, spectrum sensing, and cybersecurity frameworks that deal with efficiency, latency, and resilience in connected environments. AI and the IoT are important for sustainability and city planning. For example, smart energy management, predicting the weather in greenhouses, and using drones to monitor traffic are all examples of this. Also, the development of autonomous guided cars and Industry 5.0 automation shows how intelligent systems can be used in industrial operations. These works show how AI, IoT, and automation are coming together and how they could change the way people operate, make decisions, and solve problems in many fields. This issue shows how important it is to use ideas from many fields to drive the next generation of smart innovation.

The rapid growth of artificial intelligence (AI), the internet of things (IoT), and automation is changing industries, research methods, and the way society works. As these technologies come together, they have an effect on a wide range of areas, including healthcare, transportation, energy, manufacturing, agriculture, and smart cities. The 76 pieces in this issue show how broad, deep, and multidisciplinary modern research in these areas is. They all show how intelligent systems can change things by making predictions more accurate, making operations more efficient, making decisions better, and coming up with flexible, human-centred solutions. This editorial seeks to integrate the principal trends, methodological advancements, practical implementations, and nascent insights from the papers, offering a comprehensive view of contemporary progress and future trajectories in AI, IoT, and automation.

Artificial intelligence-powered innovation across domains

A common thread throughout the contributions is the widespread use of AI-based models for prediction, categorisation, and decision support. AI is being used more and more in healthcare to help with important clinical decisions, make diagnoses more accurate, and keep an eye on patients' health from afar. A number of research studies use convolutional neural networks (CNNs), recurrent neural networks (RNNs), long short-term memory (LSTM) networks, and transformer-based architectures to solve difficult problems in medical image analysis and signal processing. For example, PULMO-NET uses dual-modality imaging and deep learning to correctly classify lung cancer. It shows how to combine multi-scale feature extraction

with real-world deployment issues while still getting high classification accuracy. Hybrid deep learning frameworks for multi-classification of thyroid nodules utilise sophisticated segmentation techniques, feature fusion, and CNN-Maxout classifiers, attaining remarkable accuracy while addressing the difficulties posed by noise, variability, and unclear boundaries in ultrasound imaging.

AI is very useful for more than only medical diagnosis; it is also quite useful for predictive monitoring and environmental sensing. The power-LSTM model for predicting the temperature in a smart greenhouse is an example of how deep learning and time-series analysis may be used together in agriculture. It can find complicated patterns over time and help control the climate to help crops grow better. AI-powered solar radiation forecasting improves the design and use of renewable energy sources like concentrated solar power systems by giving dependable and precise estimates of irradiance. These examples show a major trend: AI is becoming more and more useful for making real-time, high-accuracy, and understandable predictions in complicated, changing systems. It is filling the gap between raw data and useful information.

Intelligent optimization and resource allocation

AI is also very useful for managing and optimising resources, especially in cloud and edge computing contexts. The rapid rise of mobile and IoT-enabled devices in 5G networks makes it hard to dynamically allocate computing and communication resources. Combining deep learning with metaheuristic optimisation methods like bird swarm optimisation (BSO) has been shown to work quite well. LSTM networks predict how many people will use a service and what the channel conditions will be, while BSO optimises offloading, power distribution, and load balancing across the network. Simulation studies show that system performance measures can improve by as much as 54%, which shows how AI could help manage resources in large networked systems in a dynamic, adaptable, and balanced way.

In the same way, combining AI with metaheuristic optimisation has been useful in cybersecurity in finding intrusions. Hybrid frameworks that use random forest (RF) classifiers to find anomalies and LSTM-based sequential attack classification to find zero-day attacks and accurately identify known intrusion types in many classes. This two-stage architecture shows that AI can help with both proactive threat avoidance and real-time system monitoring. This is very important in cloud-IoT contexts because data flows are always happening, come from many sources, and are sensitive to security.

Automation and intelligent control systems

Automation is still a big element of the research collection, especially when it comes to robots, intelligent transportation systems, and industrial processes. Research on automated guided vehicles (AGVs) shows how to use machine learning, soft computing, and optimisation-based control algorithms to plan paths, schedule tasks, and navigate industrial settings in a way that uses less energy. These studies show how important smart algorithms are for making AGVs able to work on their own in changing environments with lots of obstacles, improving safety, efficiency, and flexibility.

UAV-based traffic monitoring systems are another example of AI-enhanced automation. These systems use deep learning models like YOLO and Faster R-CNN to watch vehicles in real time, analyse traffic jams, and control traffic with high accuracy (>94%) and low latency (<40 ms). Edge AI platforms make it easier to deploy on devices with limited resources, which helps with computing limits and energy efficiency. Multi-sensor fusion makes the system more robust in difficult environmental circumstances. In the same way, embedded ADAS systems for self-driving cars use lightweight deep learning architectures to find speed-limit signs, which is very accurate and reliable. These studies show a trend toward real-time, smart, and adaptable automation that makes transportation and critical infrastructure systems safer, more reliable, and better at making decisions.

Internet of things-enabled sensing, monitoring, and smart environments

The growing number of IoT devices makes it possible to sense and monitor things all the time in many different areas. IoT networks make it possible to make decisions based on real-time data, which is useful in agriculture, healthcare, energy management, and smart cities. Smart greenhouses use IoT sensors and Power-LSTM models to show how combining environmental monitoring with AI analytics may improve temperature control, resource use, and crop yield. In healthcare, SIMO-UWB networks allow for multi-target localisation and vital sign monitoring by using time-of-arrival algorithms, trilateration, and global nearest neighbour approaches to detect distance, heart rate, and respiratory activity with high precision.

AI-based solar radiation forecasting and other energy management apps show how important predictive IoT analytics are for designing buildings that are environmentally friendly and making the most of renewable energy. These studies offer strong solutions to energy planning problems by combining machine learning methods with environmental and operational data. This shows how AI and IoT can work together across different fields to promote sustainable growth.

Human-centric artificial intelligence and emotion recognition

Numerous studies highlight AI's function in comprehending and interpreting human behaviour and emotions, encompassing facial expression recognition, activity monitoring, and emotion detection from textual data. Deep learning frameworks enhanced with hierarchical ensembles, genetic algorithm-driven feature selection, or neural network-based dynamic weighting attain elevated classification accuracy while ensuring computing efficiency for real-time applications. These contributions underscore the significance of human-centric AI systems that not only analyse data quickly but also deliver actionable insights for user interaction, mental health monitoring, and human-computer interfaces.

The addition of AI to personalised recommendation systems, such as multi-label clustering for gift suggestions, shows how important adaptive and context-aware intelligence is becoming in consumer applications. These systems use metadata, multi-label classification, and feature rating to make suggestions that are accurate, targeted, and personalised. This shows how AI is becoming more advanced and useful for improving user experiences.

Hybrid and meta-heuristic methodologies

A significant cross-cutting trend is the integration of AI with metaheuristic, evolutionary, and optimisation algorithms. These methods make things work better, more reliably, and faster in many areas. In cybersecurity, hybrid models that combine anomaly detection with time-aware LSTM-based intrusion classification work better than typical supervised machine learning methods. They are better at finding zero-day attacks and multi-class intrusions. In the same way, metaheuristic algorithms increase threat detection in power system cybersecurity by optimising deep learning architectures and hyperparameters.

Hybrid methods are also common in energy systems, robotics, and managing resources. Combining swarm intelligence or evolutionary optimisation with predictive AI models makes it possible to create adaptive, efficient, and scalable systems that can work in uncertain or changing situations. These methods show how combining domain knowledge, computational intelligence, and optimisation tactics is becoming more common to solve difficult problems in the real world.

Explainable and ethical artificial intelligence

There is a growing focus on explainable artificial intelligence (XAI) in healthcare, the internet of things (IoT), and cybersecurity. Grad-CAM and other similar methods give visual explanations of how decisions are made in medical imaging applications. This makes AI-driven diagnoses more transparent and trustworthy. Attention processes in deep learning models for intrusion detection also help us understand traffic irregularities and classify attacks. This trend shows that more and more people are realising that AI systems, especially those used in areas that are important for safety or that are sensitive to social issues, need to be clear, understandable, and morally responsible.

Interdisciplinary applications and insights

The wide range of research shows that intelligent innovation is interdisciplinary. Healthcare, energy management, agriculture, robotics, transportation, and business analytics are just a few of the areas where AI, IoT, and automation may make a difference. This shows that these technologies can be used in many different fields to create complete solutions. Cross-disciplinary collaboration is becoming more and more important for solving difficult problems in society and industry, such as smart infrastructure, precision agriculture, energy sustainability, and urban mobility. The collection also shows how important it is to make changes that are specific to a certain field, including IoT setups for monitoring greenhouses, hybrid AI for dermatology, and edge-AI-enabled traffic systems.

Emerging trends and key insights

There are a few big trends that come out of the papers:

1. Deep integration of AI: LSTMs, RNNs, CNNs, and transformers are examples of advanced neural network designs that are used in many fields to help with prediction, classification, and decision-making.
2. Real-time monitoring with IoT: sensor networks, IoT devices, and edge computing make it possible to collect data all the time and get useful information.
3. Automation and adaptive control: AI-powered autonomous systems make operations more efficient, safer, and better at making decisions in changing settings
4. Hybrid methodologies: combining AI with meta-heuristics, swarm intelligence, and optimisation makes things more accurate, strong, and efficient.
5. AI that is centred on people: AI's function in human-computer interaction is shown via emotion recognition, activity tracking, and personalised suggestions.
6. Explainable and ethical AI: in healthcare and cybersecurity, transparency, interpretability, and ethical use are becoming more and more important.

7. Working together across disciplines: AI, IoT, and automation come together in different fields to come up with complete, useful answers to tough challenges.
8. Practical Deployment and Scalability: Putting a lot of emphasis on real-world validation makes sure that solutions can be used and changed to fit operational needs.

Future directions

In the future, research in AI, IoT, and automation will probably focus on a few important areas:

1. Connecting 5G and 6G networks to IoT and AI systems to make communication faster and more reliable, and with less lag time.
2. AI systems that can grow and change as they learn from different types of data streams that are high-dimensional and real-time.
3. AI and edge computing that use less energy to cut down on processing time and environmental damage while still working with devices that don't have a lot of resources.
4. Design that puts people first and ethical guidelines to make sure AI systems respect privacy, fairness, and openness while giving useful information.
5. Cross-domain and multi-modal intelligence that combines vision, language, signal processing, and sensor fusion to help people make decisions as a whole.
6. Resilience against threats from hackers in cybersecurity, self-driving cars, and important infrastructure systems, making sure they work well and are safe.

Conclusion

This issue features 76 papers that collectively demonstrate the transformational potential of intelligent innovation in AI, IoT, and automation. They emphasise the integration of predictive modelling, real-time monitoring, autonomous control, and human-centric intelligence in tackling intricate difficulties. The contributions highlight hybrid approaches, XAI, practical deployment, and interdisciplinary applications, illustrating a developing discipline that harmonises technical complexity with societal significance. This issue offers readers a thorough examination of current developments, techniques, and applications in intelligent systems. It emphasises the significance of collaboration, ethical implementation, and empirical validation, guaranteeing that AI, IoT, and automation yield substantial advancements in healthcare, energy, agriculture, urban management, and industrial operations. This research indicates that we are at a crucial juncture in the age of intelligent systems. Through the integration of AI, IoT, and automation across several fields, researchers are advancing technological boundaries while fostering a society characterised by intelligent, adaptable, and ethical solutions that sustainably improve human life, productivity, and environmental stewardship.