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REVIEW PAPER

A Review of Artificial Intelligence and IoT in Smart Cities: Current Technologies, Uses, and Future Trends

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***Abstract*—The integration of AI with the Internet of Things (IoT) is paving the way for intelligent analysis, automated decision-making, and real-time data collection, which in turn is transforming the creation of smart cities. This article looks at how the Internet of Things (IoT) and artificial intelligence (AI) work together to make cities smarter, more flexible, and more sustainable. It emphasizes critical enabling technologies like high-tech sensors, networking protocols (such 5G and LPWAN), and artificial intelligence methods (AI) like as ML, DL, and predictive analytics. Core applications, including intelligent transportation, smart energy systems, environmental monitoring, healthcare, and public safety are examined, illustrating AIoT's impact on operational efficiency and citizen well-being. Furthermore, the paper discusses emerging trends such as 5G-Advanced, autonomous systems, AI-driven sustainability, and Digital Twins (DTs), outlining future research directions that promise to enhance resilience, scalability, and responsiveness in next-generation smart cities. The fusion of AI and IoT not only enhances service delivery and infrastructure management but also promotes data-driven governance and citizen engagement. This integration paves the way for more livable, secure, and environmentally conscious urban spaces.**

Keywords—Artificial Intelligence (AI), Internet of Things (IoT), AIoT, Smart Cities, Intelligent Infrastructure.

I. Introduction

Smart cities have emerged as a result of the increased urbanization. These urban environments utilize cutting-edge technology to improve sustainable growth, operational effectiveness, and quality of life. A smart city is one that effectively manages its assets and resources by collecting data from a network of interconnected devices and sensors that are part of the Internet of Things (IoT). This data can be used for a variety of purposes, including public safety, healthcare, transportation, and energy conservation [1][2]. This vision is about blending people, processes, and institutions as much as it is about technological innovation, in order to make cities more responsive and adaptive.

The concept of smart cities revolves around the integration of AI with the Internet of Things (IoT) [3]. IoT functions as the digital nervous system, implanting terminals and gadgets into the urban environment and gathering massive quantities of future information comprising data about traffic movement, power utilized, air quality, cases of crime in the city, and so forth. However, the real possibilities of this data can be realized when they utilize AI as the brain to process the raw information into actionable insights, predictive modelling, and automated decision-making. Combined together, in what is commonly known as IoT [4][5], this formidable duo is allowing cities to shift the management of their cities toward proactive and optimized urban governance.

Artificial intelligence and the Internet of Things play a complex role in urban change. Intelligent automation, predictive maintenance, and the tremendous improvement of service delivery in numerous fields are made possible by artificial intelligence (AI) technologies known as machine learning (ML) and deep learning (DL). These technologies can assist cities in analyzing and making sense of data streams produced by Internet of Things (IoT) sensors. As an example, AI-powered analytics could forecast infrastructure outages, the most efficient energy administration, and dynamically control traffic congestion, and IoT would guarantee that all urban systems are regularly updated and that connectivity is persistent. Such integration not only results in increased efficiency in the operations, but it also allows more sustainable and resilient cities to be developed [6].

The driving force behind the AI-IoT synergy in smart cities comes as a result of the necessity to deal with complex urban problems that cannot be handled using tradition methods. The explosion in the number of people living in urban areas puts an unprecedented pressure on infrastructure, resources as well as services and there is a need to have innovative solutions that will be able to be flexible to the dynamic and often unpredictable conditions. The revolutionary aspect of AIoT is to provide situational awareness and data-driven decisions in real-time and adapt to new problems like environmental sustainability, population health, and security risks to the population [7].

In addition to this, the AI-IoT combination is critical in promoting participatory urban planning as well as citizen-centric governance. AIoT platforms may enable more open, participatory, and interactive government services by using the information gathered by many different sources, such as citizens, devices, and city infrastructure. The urban population's standard of living is enhanced, and so are the stakeholders' when they are given the tools to actively participate in their cities' growth [8].

To conclude, the combination of AI and IoT symbolizes a paradigm shift in the understanding and way of administration of smart cities. The AIoT environment allows cities to be smarter, adaptable, and sustainability-conscious, which will form the basis of future advancements and resilient urban systems by using pervasive sensing and advanced analytics and automation. This review the paper discusses some of the technologies, applications, challenges, and future trends associated with AI-IoT synergetic view of smart cities and gives an overall insight into the transformational opportunities that the developments hold [9].

A. Structure of the Paper

This paper is organized in the following way: How AI and the Internet of Things work together in smart cities is covered in Section II. The fundamental enabling technologies are described in Section III. Emerging trends and important applications are covered in Section IV. A review of the relevant literature is provided in Section V, and recommendations for further study are given in Section VI.

II. The Synergy of Artificial Intelligence And IoT

The aim of AI research and development is to provide computers with human-like thought, learning, and decision-making capabilities. Among the most fundamental branches of AI are ML [10], DL, NLP, and computer vision. Each of these branches of AI is valuable, allowing machines to make sense of data, understand patterns, make predictions, and automate complex tasks.

The Internet of Things (IoT) is a system that links physical things to a network of software, data, and sensors, allowing for the collection and distribution of data in real-time. IoT devices can range from home appliances to industrial machines, vehicles, and components of urban infrastructure.

As complementary technologies, AI and IoT each serve different functions [11]. IoT does the primary work of sensing and collecting massive data from the physical world and AI does the analysis of that data to pull out insights, find trends, and make intelligent decisions [12]. Raw data is transformed into actionable insight through the combination of IoT and AI.

A. Artificial Intelligence of Things (AIoT): The Intelligent Nervous System of Smart Cities

A cornerstone of contemporary smart cities is the merging of AI with the IoT, usually abbreviated as AIoT. This fusion creates an intelligent, adaptive, and self-regulating urban ecosystem. The analogy of a biological nervous system is especially fitting: IoT devices serve as sensory receptors, continuously capturing data from the physical environment, while AI acts as the central nervous system or brain, analyzing this data [13], identifying patterns, and initiating intelligent responses in real time.

In smart cities, A IoT enables a new level of situational awareness and operational intelligence. It allows systems to observe, learn, and act automatically and with minimal human intervention. The efficiency and responsiveness of public services are both improved by this paradigm, which also improves the operation of urban infrastructure.

B. Real-world Applications of AIoT in Smart Cities

- **Traffic Management:** Using real-time traffic data collected from cameras and IoT devices, AI systems may dynamically alter signal timings, ease congestion, and redirect traffic during accidents or peak hours.
- **Smart Energy Systems: AI** algorithms monitor energy demand and usage patterns via smart meters and IoT devices [14], enabling grid operators to optimize energy distribution, integrate renewable sources, and prevent outages.
- **Public Safety and Surveillance:** AI-based facial and behavior recognition systems combined with surveillance cameras identify anomalous activity, identify threats, and alert law enforcement instantly, ensuring faster response times.
- **Waste and Water Management:** Smart bins and water meters use IoT sensors to monitor usage and fill levels, while AI predicts maintenance needs and optimizes collection or distribution schedules [15].
- **Environmental Monitoring:** AIoT can track air quality, noise levels, temperature, and pollution data to inform policy decisions and alert citizens to hazardous conditions. Figure 1 shows every AIoT application in smart cities:

Fig. 1. Applications of AIoT in Smart Cities

The Internet of Things also makes predictive analytics possible, which means that authorities and planners can foresee potential issues like infrastructure breakdowns or surges in energy demand and take preventative measures. Over time, as more data is collected and processed, these systems become more intelligent, allowing for adaptive urban planning and continuous optimization.

Ultimately, AIoT transitions cities from reactive to proactive governance models, where decisions are data-driven, timely, and context-aware. It empowers cities not just to function more efficiently, but to thrive, offering enhanced sustainability, citizen engagement, and a higher overall quality of life.

III. Core Technologies Enabling AI and IoT in Smart Cities

Digital infrastructure must be flawlessly integrated with important technologies like AI, the IoT, and others for a smart city to exist. In order to collect data in real-time on anything from traffic patterns to weather forecasts, IoT acts as the "perception layer," tying together cities' extensive networks of sensors, actuators, and smart devices. They have different means of communication but most products rely on a series of protocols and networks which include Wi-Fi, 5G, LPWAN, and Bluetooth Low Energy to guarantee reliability in connectivity and transmission of data between the constrained and unconstrained nodes.

Information harvested using IoT devices is directed to a centralized or distributed platform where it is processed and stored in data lakes or data warehouses and this provides the opportunity to manage structured and unstructured data [16].

This data is subjected to advanced analytics such as predictive, descriptive and decision models that are used to predict, explain causality and assist in decision-making in urban areas as shown in Figure 2.

Fig. 2. AI and IoT in Smart Cities

The confluence of AI and the IoT is a fundamental factor in the radical shift in the general image of modern cities. In smart cities, IoT monitoring becomes a cohesive network of sensations, with sensors and devices installed at all levels of the infrastructure, in roads and transit, in water and power, and in government-shared facilities to convey immediate information of all types, including traffic patterns and electricity use, along with air quality and community safety. This makes up a huge and intertwined network of data, which is the backbone of any intelligent city and allows cities to continuously monitor, manage and optimize resources as ever before.

A. Internet of Things (IoT) in Smart City

The IoT is the foundation of a network of smart cities, which integrates sensors, actuators, and intelligent devices into the urban setting to automatically respond to common events and collect data in real time. The IoT architecture of smart cities is usually multi-layered, including such layers as perception (device), network (connectivity), edge computing, middleware (data processing), application, business, and security layers:

- **Sensors and devices:** This is implemented in various spheres of the city, including transportation, energy, health, and environment, to evaluate parameters such as the flow of traffic, air quality, and spending utilities, etc. The different devices are simple sensors up to complex actuators and embedded systems which are able to communicate with their environment.
- **Connectivity:** IoT devices can communicate through various protocols and networks, such as Wi-Fi, cellular (4G/5G), LPWAN, Bluetooth Low Energy, and highly specialized ones, like MQTT and CoAP, which guarantee the smooth transfer of data across devices and to the central systems.
- **Information Gathering and real-time observation:** With the incorporation, there will be continuity in observing the situation in the city in real-time thus assisting in prompt actions and management of the city. The data are relayed to gateways and cloud environments and are clustered and exposed to additional study and operations [17].

B. Artificial Intelligence (AI) in Smart Cities

The Internet of Things (IoT) generates massive amounts of data every day; artificial intelligence (AI) is crucial for smart cities to help them embrace proactive management methods and benefit from this data.

- Forms of Artificial Intelligence (AI) The three main forms of AI that are used in smart cities are ML, DL, and predictive analytics [18]. The techniques are applied to map out trends, predict the future, and enhance city operations in all fields, including the management of traffic, power supply, and safety.
- Automation and the Elimination of Psychology Bias: AI technologies enable automated decision-making through real-time data evaluation and transmission. For instance, AI has the ability to automate the deployment of resources during emergencies, optimize traffic signals in real-time to prevent congestion, and predict when equipment will fail so that maintenance can be done promptly [19].

IV. Applications And Future Trends of AI and IoT Synergy in Smart Cities

The ability of AI and the IoT to collect data instantly, analyze it intelligently, and make automated judgments on urban barometers is drastically altering how smart cities operate. The IoT sensors in infrastructure, transportation networks, utilities, and the public area may continuously gather information on things like public safety, energy consumption, traffic movement, and air quality. The enormous volume of data is processed by AI algorithms to maximize resources and predictive maintenance services, as well as to enhance resident rates and quality of life through more intelligent service delivery. Whatever is intelligent energy management, smart grids, real-time traffic management, environmental monitoring, intelligent healthcare and smart public safety services, every application can combine AI and IoT [20]. Besides being cost-effective and facilitating an efficient running of the cities, this integration will increase citizens' participation and visibility, making smart cities resilient, adaptive, and people-centred urban systems [21].

A. Smart Infrastructure and Buildings

AI and IoT are revolutionizing urban infrastructure by enabling intelligent energy consumption and smart grids. Buildings and utility network sensors optimize energy distribution, minimize peak loads, and optimize operations, while enhancing comfort and operational efficiency.

B. Intelligent Transportation and Mobility

One step of the AI-IoT synergy in urban areas is smart mobility. The foundation of real-time traffic control is the use of cameras and IoT sensors to collect data on vehicle movement, traffic, and any events. AI uses this information to determine congestion, control and change traffic lights and optimize bus routes [22]. Deployment of autonomous cars and interconnected public transportation leads to further efficiency, safety, quality of the commuting process, less pollution, and traffic jams in cities.

C. Monitoring the Environment and Sustainability

Internet of Things (IoT) devices track air and water quality while analyzing pollution trends. AI evaluates data to take prompt action. IoT-compatible bins and AI logistics are used in smart garbage management systems.

D. Department of Public Safety and Security

IoT-enabled cameras and sensors together with AI-driven surveillance enhance the security of people by checking on threats in real-time and making possible for police actions in advance. These technologies can detect abnormal behaviour, mobilize resources in times of crisis and also manage resources effectively.

E. Well-Being and Healthcare

IoT devices in smart healthcare enable remote patient monitoring, anomaly early detection, and individualized health insights. AI-processed diagnostics facilitate clinical decision-making and streamline hospital operations, improving patient care and reducing healthcare expenses.

F. Future Trends and Research Directions

The trends point toward increasingly intelligent, resilient, and sustainable urban environments, where the synergy of AI and IoT, supported by robust connectivity and advanced computational paradigms, will propel the next wave of innovation in smart cities.

1) Evolution Toward 5G-Advanced and Ultra-Reliable Connectivity

There are some high-end development opportunities in the connectivity, smart automation, and data-driven city management, which is transforming the growth of smart cities. A shift to 5G-Advanced and ultra-reliable communications is one of the most dramatic trends as it offers high-performance rates and low-latency communication is essential for autonomous infrastructure to operate well and for real-time IoT applications. The next-generation connectivity will allow cities to host enormous amounts of interconnected devices, provide reliable remote support, and make the essential urban services more responsive.

Another characteristic trend is the emergence of autonomous systems and despite catastrophe-evoking images, they are robotics. The most notable application is in transportation of goods and people, waste management, and inspection of infrastructure by cities [23]. Self-driving cars, drones, and service robots are increasingly being used. The systems apply AI and IoT to become autonomous and resilient to dynamic conditions improving efficiency and safety in any urban activity, liberating the human resources to engage in more complicated tasks.

2) AI-Driven Sustainability and Emerging Paradigms

The use of AI toward sustainability and climate resiliency is emerging as a dominant smart city strategy. Machine learning models and advanced analytics are being established to minimize energy use and renewable integration and assess the environment in real time. They allow cities to address their environmental emissions, operate more efficiently, and react in advance to environmental hazards to help in long-term urban sustainability.

Edge AI, federated learning, and digital twins are transforming smart infrastructure in cities. Edge AI reduces latency, enabling quicker decision-making in traffic control [24]. Federated learning increases privacy and security without raw data. Digital twins provide planning, predictive maintenance, and real-time data visualization.

V. LITERATURE REVIEW

The literature on smart city AI/IoT collaboration is reviewed in depth. For the sake of clarity and reference, Table I presents a summary of the important investigations.

Lin, Pan and Luo (2025) employ scient metric methods to analyze AI implementation in the framework of smart cities. It investigates how AI is affecting and developing in relation to handy services, especially those powered by mobile communications and the IoT. The Web of Science (WoS) database yielded 1,284 research articles published between 1975 and 2025. The data from these papers were visualized and analyzed using VOS viewer and Bibliometric software, with a focus on research hotspots, development trends, key authors and institutions, and the interdisciplinary integration across various fields [25].

Rafique et al. (2025) give a detailed taxonomy of the B5G network slicing framework requirements, design, dynamic intra-slice and inter-slice resource allocation techniques, management and orchestration, artificial intelligence/machine learning-empowered network slicing designs, implementation testbeds, 3GPP specifications and projects/standards for B5G network slicing. Smart cities vertical offers unique service characteristics, performance requirements, and technical challenges in B5G network slicing. Therefore, this paper provides a comprehensive survey on B5G network slicing use cases, synergies, practical implementations and applications based on their quality of service parameters for smart cities applications [26].

Deng (2024) provides a mathematical model for processing data in smart city IoT that combines the ant colony algorithm with the BP algorithm. Data transmission and storage optimization is accomplished using the ant colony approach, whereas the raw data is pre-processed and classified using the BP algorithm, which divides the data into multiple processing steps. A solid technological foundation for the development of smart cities might be laid by this model, which has the potential to improve the accuracy and velocity of data processing. This study offers new concepts and methods for data processing in future smart cities, which will considerably aid the progress of IoT technology in smart cities [27].

Ramal and Anbalagan (2024) emphasizes the pivotal role of cloud computing in harnessing and processing the extensive datasets, ensuring that smart cities can derive actionable insights for informed decision-making. The suggested method relies heavily on the creation of a hybrid infrastructure, which makes use of many resources to improve dependability and efficiency. The envisioned synergy between Interaction-Based Industry 5.0, Digital Twin, and cloud computing is poised to revolutionize urban planning, administration, and overall intelligence in smart cities [28].

Zainab and Bawanay (2023) explore the applications of converging these technologies across diverse industries, showcasing how Digital Twins reshape conventional practices and amplify the idea of smart cities via the Metaverse's immersive environment. However, the exploration unveils challenges, particularly in data privacy, interoperability, and ethical considerations. The study advocates for a balanced and informed approach, emphasizing that the symbiotic relationship between Digital Twins and the Metaverse should steer the evolution of Smart Cities toward security, innovation, and interconnected urban spaces [29].

Talebkhah et al. (2021) prepare to handle the main problem with smart cities. To achieve this goal, they will lay out the fundamentals of smart city design, composition, and real-world applications before diving into the concept, requirements, and characteristics of these urban planning marvels. In addition, potential obstacles and openings in the smart city sector. Research improves the development of applications for the aforementioned technologies by introducing new concerns and challenges, such as analytics and the use of big data in smart cities. Consequently, the problems and difficulties associated with big data applications in smart cities can be further investigated using the findings of this study [30].

Table I provides a synopsis of relevant work pertaining to smart cities and AI/IoT. It also includes the study, methodology, key findings, difficulties, and constraints listed in the table that follows:

TABLE I. SUMMARY OF RELATED WORK BASED ON ARTIFICIAL INTELLIGENCE AND IOT SYNERGY IN SMART CITIES

Reference	Study On	Approach	Key Findings	Challenges	Limitations
Lin, Pan & Luo (2025)	Science-based evaluation of AI in smart cities	Bibliometric and scientometric review using WoS data, VOSviewer, and Bibliometrix	Identified research hotspots, development trends, key contributors, and interdisciplinary integration	Rapid evolution of the field makes static mapping difficult	No technical performance analysis or real-world validation
Rafique et al. (2025)	B5G network slicing for smart cities	Systematic taxonomy and survey of 3GPP specs, AI-driven slicing, use cases	Comprehensive view of network slicing for smart cities, highlighting dynamic resource allocation	Complex intra-/inter-slice orchestration for heterogeneous services	Focuses primarily on network-layer issues; lacks implementation depth
Deng (2024)	AI algorithms for IoT data processing	Mathematical modelling using BP and ant colony algorithms	Improved speed and accuracy in smart city IoT data handling	Scalability of hybrid algorithm in large-scale deployments	Simulated model; lacks real-world deployment or benchmarking
Ramal & Anbalagan (2024)	Cloud computing and Industry 5.0 in smart cities	Conceptual hybrid infrastructure integrating cloud, Digital Twins, and Industry 5.0	Hybrid model improves data handling, reliability, and urban planning intelligence	Integration complexity across multiple paradigms	Theoretical approach; lacks performance evaluation
Zainab & Bawanay (2023)	Digital Twins and Metaverse in Smart Cities	Exploratory study across industries	Digital Twins enhance smart city interactivity via immersive tech	Data privacy, ethical issues, and interoperability concerns	Emerging concept; lacks large-scale empirical data
Talebkhah et al. (2021)	General overview of smart city systems	Conceptual and architectural analysis	Highlights architecture, implementations, and big data opportunities	Need for advanced analytics and big data strategies	General discussion; lacks technical specificity and models

VI. CONCLUSION AND FUTURE WORK

Smart cities are undergoing a radical transformation as a result of the integration of AI and the Internet of Things (IoT), which enables real-time monitoring, intelligent decision-making, and automated municipal administration. The Internet of Things (IoT) enhances city life by facilitating better traffic management, energy optimization, healthcare, public safety, and environmental monitoring. New technologies such as digital twins, edge AI, 5G, and federated learning are driving the need to construct resilient and adaptive infrastructures in today's data-driven and interconnected cities. Research on scalable AI models, privacy-preserving data exchange, and strong policy frameworks to support autonomous urban systems should be prioritized in the future. The development of AIoT is dependent on the success of future smart cities in meeting a variety of needs, including increased efficiency, responsiveness, accessibility, safety, and environmental sustainability.

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