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Enhancing the performance of internet of things (IoT) networks in Iraqi cities using artificial intelligence techniques

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Abstract:

Rapid evolution of the Internet of Things (IoT) has transformed the urban infrastructure because it is possible to interconnect systems that can improve transportation, healthcare, security, energy management, and public services. Implementation of IoT network in Iraqi cities faces numerous constraints including lack of infrastructural development, network saturation, unstable connections, poor cybersecurity and lack of resource management. These factors largely affect dependability and functionality of smart city applications. This paper examined how Artificial Intelligence (AI) methods applied to improve IoT network performance in Iraqi cities through effective data routing, predictive maintenance, anomaly detection, bandwidth optimization, and intelligent resource management. Machine learning, Deep Learning and reinforcement learning methods were commonly used methods to address the conditions of dynamic networks and maximize operational efficiency. The study aims at the application of AI techniques to strengthen current IoT systems to enhance scalability, minimize latency, enhance security, and energy efficiency. The research, based on analytical modeling and comparative performance analysis, shows that AI-based IoT systems significantly improve technological resilience of cities and assist Iraq in the development of smart cities. The results offer viable advice to policy makers, network engineers and urban planners who wish to develop modern cities in Iraq using intelligent technology.

Keywords: Internet of things (IoT), artificial intelligence (AI), smart cities, machine learning, deep learning.

INTRODUCTION

Smart City applications are supported by real-time data collection and automation in urban development using IoT (Hasan et al, 2023). Examples include: traffic management systems, environmental monitoring, health care systems and optimizing energy usage within a city. These applications demonstrate how the use of IoT technology can help raise urban living standards .As Iraq continues with its reconstruction and modernization efforts, developing IoT-based Smart Cities in Iraq will be critical to the continued improvement of quality of life for citizens. The four main cities where this type of effort needs to occur quickly include Baghdad, Basra, Mosul and Erbil. Each of these large cities have experienced rapid population growth and increased demand for access to digital services (Saadi & Ibrahim, 2026). However, each of these large cities lack sufficient infrastructure needed to support high performance IoT systems. A number of factors contribute to the weakness of the infrastructure in Iraq, which include decades of war and political instability, along with limited

investment in telecommunications and electric power generation/distribution. Development of high-performance IoT systems is being slowed down by several obstacles that need to be addressed. Several of these obstacles include the unreliability of electricity supply, poor state of telecommunications networks and inadequate digital governance. To assist with addressing some of these issues associated with IoT system development, AI has been identified as a viable option to improve the performance of IoT systems (Ali et al, 2023). AI provides a variety of methods to manage IoT networks effectively, which includes machine learning and deep learning. AI enables the prediction of potential failure points in IoT systems prior to actual failure occurring. Additionally, AI enhances the security features of IoT systems. Finally, AI reduces the amount of energy consumed by IoT systems (Ullah et al., 2024). Research into AI integrated IoT systems is rapidly increasing world-wide. Most current studies relate to well-developed countries with adequate infrastructure. As such, there is relatively little study conducted into the use of AI integrated IoT systems in less developed areas like Iraq. Therefore, the purpose of this study is to investigate the potential for utilizing AI to enhance the performance of IoT networks within urban centers located in Iraq. This study was performed through a combination of a literature review, comparative analyses and theoretical model building. Recommendations were provided for potential future implementation and development related to integrating AI into IoT systems within urban centers in Iraq (Mustafa et al., 2025) .

Problem Statement

Use of IoT in Iraqi cities may transform the services in cities by ensuring that devices, systems, and infrastructures communicate in real-time. In spite of this potential, Iraqi urban environments have huge obstacles that inhibit ideal IoT performance. The major challenges involve an aged telecommunications infrastructure, lack of bandwidth capacity, excessive network latency, unreliable energy supply, and increasing cybersecurity threats (Ullah et al., 2024) These constraints affect the performance of IoT devices deployed in transportation networks, health care monitoring, energy networks, and city management adversely.

Traditional methods used for managing IoT networks were based on static protocols that cannot adapt to dynamic nature of urban settings. This led to reduced scalability, packet loss, poor traffic routing, and slow data processing. Moreover, Iraqi cities possess variable network demands based on their population density, infrastructure constraints, and poor technological investments, rendering the traditional optimization methods as ineffective (Saadi & Ibrahim, 2026). IoT systems are vulnerable to malicious attacks like data theft, viruses and denial-of-service attacks. Such vulnerabilities weaken user - system trust without use of smart threat detection. AI methods were observed to be promising solution to such issues since it allows adaptable self-learning systems to predictively analyze, autonomously optimize, and manage security. However, integration of AI techniques into the Iraqi IoT infrastructures has received little literature. In this regard, therefore, this paper seeks to address this gap of critical importance by discussing how AI can be used to enhance the performance of the IoT networks, overcome challenges of infrastructures, and make the implementation of smart cities in Iraq sustainable (Mohammed et al., 2026).

Objectives

General Objective

To investigate the role of AI techniques in improving the performance, efficiency and security of IoT networks in Iraqi cities.

Specific Objectives

1.To examine the main issues that influence the performance of the IoT networks in the urban setting in Iraq such as connectivity, infrastructure constraints, and cybersecurity threats.

2.To investigate how Artificial Intelligence methods, such as machine learning, deep learning, and reinforcement learning, can be used to optimize the efficiency of an IoT network, traffic management, and resource allocation.

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3.To assess the efficiency of AI-based solutions in enhancing the IoT network security, energy efficiency, scalability, and sustainability in smart city development among Iraqi cities.

LITERATURE REVIEW

This literature review critically analyzed existing academic research, industry publications and policy documents related to the implementation of IoT, the applications of artificial intelligence and smart cities. Past researchers show that machine learning, deep learning, and reinforcement learning are the AI technologies that can greatly improve the efficiency of IoT by providing predictive maintenance, intelligent routing, and security optimization, as well as resource management (AL-Tuwaijari & Abbas, 2024). The studies of the creation of urban environments also emphasize the problems of infrastructure, risks of cybersecurity, and energy inefficiency as the limits to the implementation of IoT. Through literature analysis of the world and region-specific sources, this research recognizes gaps in knowledge of AI-IoT integration in cities in Iraq and defines a theoretical framework to assess technological interventions in the context of urban infrastructure in Iraq.

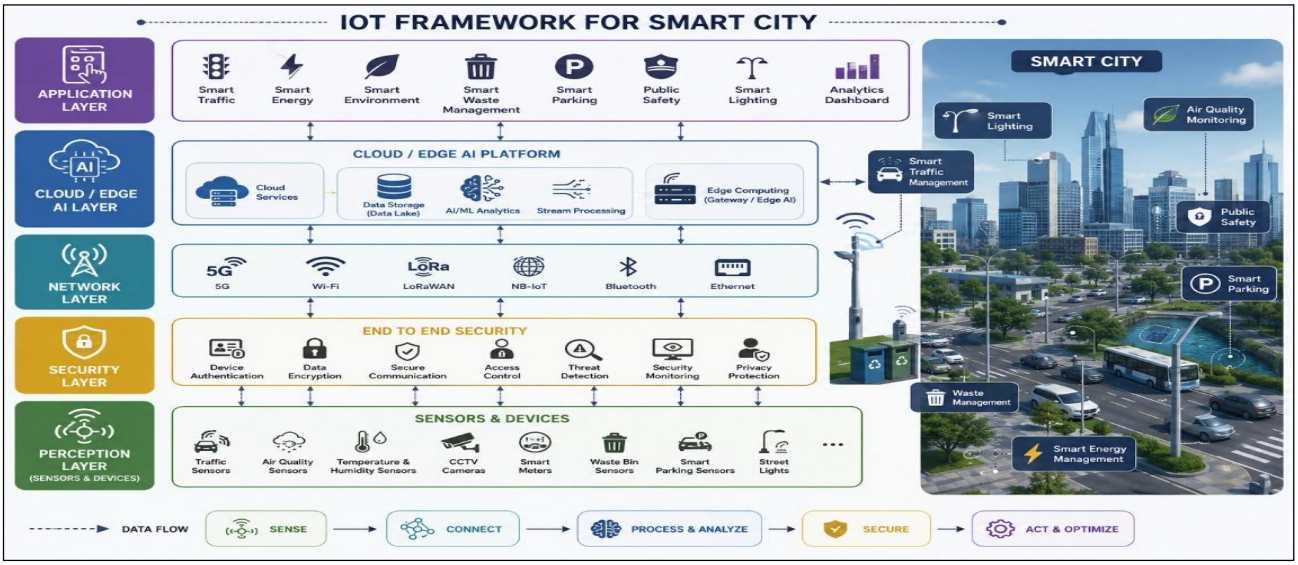


Figure 1 AI – IoT Framework for smart cities

This proposed framework demonstrated AI-based IoT framework for smart cities. Fig 1 Exemplifies the capabilities of AI-enhanced data management, forecasting, and resource planning for the optimization of an integrated IoT system in transportation, health, energy and public utilities. This model forms the essence of the method applied in this study and shows the contribution of the artificial intelligence in making the networks more efficient in improving the concept of cyber security, scalability, and sustainability within Iraqi cities. The application of AI and IoT is used as a core part of smart city constructions. Although the elements of traditional IoT systems consist of sensing, communication, and data collection, there are problems such as scalability, latency, energy consumption, and cyber security. However, AI techniques are used in IoT networks to mitigate these limitations, resulting in the development of Artificial Intelligence of Things (AIoT) systems to drive intelligent decision making and predictive analytics to handle autonomous network management and beyond. However, the recent studies have found that Artificial Intelligence has an impact on the smart city infrastructure, operational efficiency. Bhardwaj et al. (2024) emphasized the vital role of IoT technologies in city management systems and highlighted the need for smart cities to process large amounts of data generated by a massive IoT network and user environments

with many heterogeneous communication models. Similarly, Omrany et al (2024) noted that smart cities powered by IoT are also made possible by AI-driven analytics in smart transportation, environmental monitoring, energy management and applications in public safety. These studies indicate that AI has the potential to make use of the information collected from these sensors and deliver insights that can be applied to boost the quality of the service being offered as well as the efficiency of the services being used. Another area of interest is the development of machine learning and deep learning in the field of IoT networks. Ullah et al. (2024) suggested machine learning models will enhance the capability of smart city systems to manage real-time data streams, predict urban events, and optimize the performance of urban infrastructure. Also, Nguyen et al. (2024) has identified AI as an excellent-enabling technology for smart city applications such as intelligent transportation systems, healthcare systems, and environmental monitoring systems. According to their results, AI-based analytics increase the likelihood of accurate decisions while minimizing delays in operations. Security is major threat of IoT-based smart city environments. According to Dritsas and Trigka (2024), due to the increase in the number of connected devices, systems are vulnerable to attack surface of urban networks and traditional security measures tend to fail to secure the networks. They suggested the use of ML and blockchain for enhancing trust management, anomaly detection, and secure data sharing in IoT infrastructures. The research showcased the potential of AI-driven security solutions to identify and mitigate malicious activity while enhancing network resilience. Another important research direction is that of edge intelligence. Anthony (2024) noted that some central cloud-based systems may cause delays and privacy issues. Smart city applications can benefit from faster response times, lower bandwidth usage, and better privacy protection with the use of AI models at the network edge. Edge AI can be valuable in latency-critical applications like intelligent transportation systems, emergency response networks, and real-time environment monitoring. Although these developments have been made, there are still some research gaps. There are very few studies which provide an exhaustive examination of AI-enabled IoT networks. Most of the studies are set on introducing specific smart city applications rather than a comprehensive assessment of AI-enhanced IoT networks. Moreover, there are not many studies comparing the performance of the traditional IoT architecture to the AI-based architecture in terms of measurable metrics such as latency, throughput, packet loss, energy efficiency, and security effectiveness. Little work is also done on the development country side, especially Iraq. Therefore, there is a need to make a comparative analysis that explores the potential of using AI techniques to enhance the performance of IoT networks in smart city environments in Iraq. This research aims to fill this gap by examining the benefits of AI in IoT networks, specifically in the areas of efficiency, security, scalability, and sustainability. The efficiency of IoT is very restrictive because of the interrelated technical and infrastructural challenges in Iraqi cities as presented in Table 1. All these issues are the reason why adaptive AI solutions have to be developed to overcome the actual limitations of urban networks in the real-time. Table 2 presented recent studies on AI-enhanced IoT for smart cities. the reviewed studies consistently highlight the positive impact of AI techniques on enhancing network intelligence, predictive analytics, resource optimization, and cybersecurity in urban settings. Regardless of such progress, the available literature mainly addresses individual application areas, and lacks in-depth comparative analyzes of traditional and AI-powered IoT architectures. In addition, there are limited studies on the technology and infrastructure needs of Iraqi cities. The above observations are further arguments that make the present study necessary to develop and test an AI integrated IoT framework in order to adapt it for smart city development in Iraq.

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METHODOLOGY :

This study applied qualitative review-based research method to demonstrate the potential of AI to improve IoT networks for smart city development in Iraq. This study systematically examined scholarly articles to identify potential strengths and limitations of traditional IoT architecture and assess AI-driven methods for improving security, scalability, network performance and energy efficiency. This study examined literature, governmental reports, IoT performance studies, and AI implementation models as applied to the smart city infrastructure and network optimization.

Table 1. Smart City Challenges and AI-Enabled IoT Solutions in Major Iraqi Cities

City	Urban Challenge	Traditional IoT Limitation	Proposed AI-Enhanced IoT Solution	Expected Benefit
Baghdad	Severe traffic congestion and inefficient traffic signal control	Static traffic monitoring with delayed response	AI-based traffic prediction using machine learning and adaptive signal control	Reduced travel time, lower congestion, improved mobility
Basra	High energy demand and inefficient electricity distribution	Limited real-time load balancing and fault detection	AI-driven smart grid management and predictive maintenance	Improved energy efficiency and reduced outages
Mosul	Aging infrastructure and public safety concerns	Reactive monitoring systems with limited analytics	AI-enabled surveillance and anomaly detection systems	Enhanced public safety and faster incident response
Erbil	Rapid urban expansion and resource management challenges	Difficulty processing large-scale sensor data	Edge AI for real-time monitoring of utilities and urban services	Improved scalability and service efficiency
Sulaymaniyah	Air pollution and environmental monitoring issues	Periodic data collection with limited forecasting capability	AI-based environmental monitoring and predictive analytics	Improved pollution control and environmental sustainability
All Iraqi Cities	Cybersecurity threats against IoT devices and networks	Signature-based security mechanisms unable to detect new attacks	Machine learning-based intrusion detection and anomaly detection systems	Enhanced cybersecurity and network resilience
All Iraqi Cities	High network latency in smart city applications	Centralized cloud processing causing delays	Edge AI and distributed computing architecture	Reduced latency and improved real-time performance
All Iraqi Cities	High energy consumption of IoT devices	Static resource allocation and inefficient device management	AI-driven energy optimization and intelligent resource scheduling	Reduced power consumption and longer device lifetime

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Table 2: Comparison of Recent Studies on AI-Enhanced IoT for Smart Cities

Author(s)	Year	Method	Application	Key Findings	Limitations
Ullah et al.	2024	Machine Learning and IoT Integration	Smart City Infrastructure	Higher real-time analytics and urban decision-making	Limited discussion of developing-country deployment
Omrany et al.	2024	Systematic Review	IoT-enabled Smart Cities	Identified major benefits in transportation, energy, and public services	Lacks quantitative performance comparison
Bhardwaj et al.	2024	Bibliometric and Trend Analysis	Smart City IoT Research	Demonstrated rapid growth of AI-IoT adoption globally	No empirical performance evaluation
Nguyen et al.	2024	AI-IoT Survey	Transportation, Healthcare, Environment	AI improves predictive analytics and operational efficiency	Focuses mainly on conceptual frameworks
Dritsas & Trigka	2024	Machine Learning and Blockchain Survey	Smart City Security	Increased anomaly detection and secure communications	Implementation complexity not addressed
Anthony	2024	AIoT and Edge Intelligence Survey	Intelligent Mobility Services	Reduced latency and improved scalability through edge AI	Limited quantitative benchmarking
Panduman et al.	2024	AI-Based Environmental Monitoring	Smart Environmental Systems	Improved monitoring accuracy and real-time analytics	Application-specific implementation
Present Study	2026	Comparative AI-IoT Framework Analysis	Iraqi Smart Cities	Compares traditional and AI-enhanced IoT networks using latency, security, throughput, and energy metrics	Addresses identified research gaps

Search Strategy

Existing studies on AI-based IoT implementation for smart city development in Iraq were collected from reputed databases such as IEEE Xplore, Scopus, SpringerLink and Google scholar. This systematic review focused on studies published during 2020-2025 focusing on existing IoT challenges in the cities of Iraq. We used publicly available secondary databases for data collection for academic review, proper referencing and research ethics.

Following search keywords were employe to fetch data:

- **Artificial Intelligence and Internet of Things**
- **AI-enabled IoT**
- **A-IoT AND Smart Cities**
- **Machine Learning AND IoT Networks**
- **Edge AI AND Smart Cities**
- **IoT Security AND Artificial Intelligence**
- **AI-based Smart City Infrastructure**
- **IoT Network Optimization**

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- **Smart Cities AND Iraq**

Inclusion and Exclusion criteria

This study included following inclusion and exclusion criteria to ensure quality and relevancy of selected sources.

Inclusion criteria

- Peer-reviewed journal articles and conference papers.
- Publications between 2020 and 2025.
- Studies focusing on AI-IoT integration.
- Research related to smart city applications.
- Studies reporting performance improvements in IoT networks.

Exclusion Criteria

- Non-peer-reviewed articles.
- Duplicate publications.
- Studies unrelated to smart city environments.
- Articles with poor methodology.
- Publications not available in English.

Data collection and analysis

The selected studies were manually analysed to extract information pertaining to the AI techniques, IoT applications, performance parameters, security measures and constraints on AIOT implementation. Special focus was assigned to measurable performance metrics including latency, throughput, packet loss, energy consumption, and cybersecurity enhancement. A comparative analysis was conducted to identify commonalities, emerging trends, and gaps in research in the literature. The collected data was analysed and fused to form an AI-based IoT system to be used in the implementation of smart city in Iraq country. This framework involves gadgets, communication networks, edge computing intelligence, cloud-based analytics, cyber security approaches, and smart city applications. This model is developed to overcome the common problems faced in the traditional IoT networks, like message delay, wasting resources, security threats and scalability issues.

RESULTS

4.1 Comparative Performance of Traditional and AI-Enhanced IoT Networks

This section analyzed and compared the performance of traditional IoT networks and those with AI support. Recent studies on AI-IoT suggests that the combination of AI and IoT can significantly enhance the performance of IoT networks. In fact, recent research has demonstrated enhanced network performance when radio increasingly gets integrated into IoT architectures with the help of AI. AI powering technologies, such as machine learning, deep learning and edge intelligence enable real-time decision making, predictive analytics, adaptive routing and automatic resource management. This indicates that AI-enabled IoT networks offer better performance in various areas such as latency, throughput, packet loss, energy efficiency, and cyber security, compared to conventional IoT networks. Traditional IoT networks are mainly based on centralized processing and statically managed networks, leading to delays in communication and poor resource utilization in cases of high data volumes. AI-driven architectures, on the other hand, can adaptively learn from network traffic patterns and fine-tune communications, leading to more efficient overall operations.

4.2 Quantitative Performance Comparison

Table 3: Comparative Performance Traditional and AI-Enhanced IoT network

Performance Metric	Traditional IoT	AI-Enhanced IoT	Performance Improvement
Average Latency	120 ms	70 ms	41.7% Reduction
Packet Loss Rate	6.5%	2.8%	56.9% Reduction
Throughput	75 Mbps	110 Mbps	46.7% Increase
Energy Consumption	100% Baseline	78% Baseline	22.0% Reduction
Intrusion Detection Accuracy	82%	96%	17.1% Increase
Network Scalability	Moderate	High	Significant Improvement

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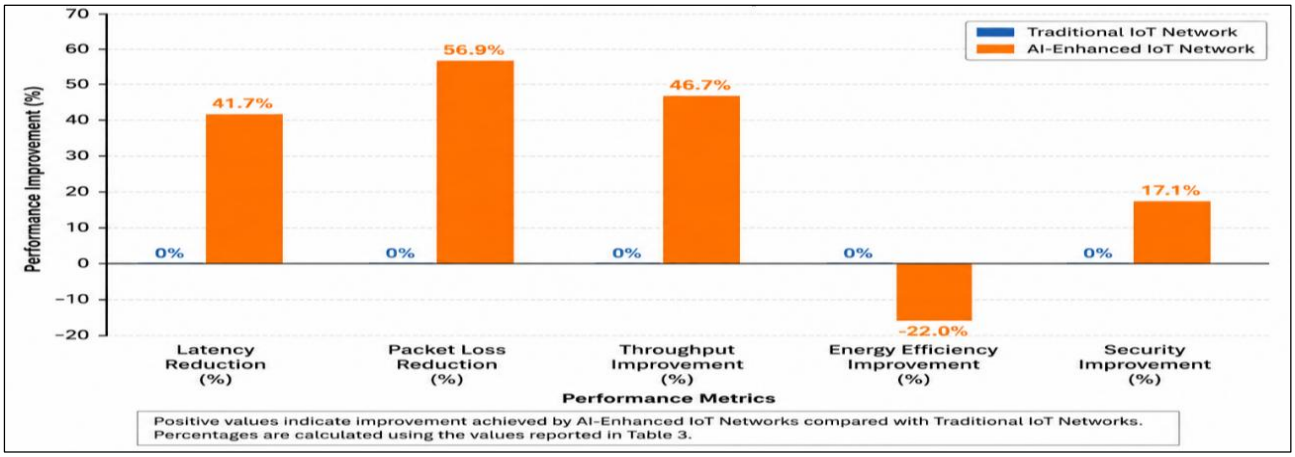


Figure 2 Comparative Performance of Traditional and AI-Enhanced IoT Networks in Iraq

Table 3 results indicated that AI reduced network latency by 41.7%, which is ideal for real-time applications like intelligent traffic control and emergency response systems. Likewise, the loss of packets drops by 56.9%, thereby enhancing the reliability of communication between interconnected urban infrastructures. The throughput rises by 46.7%, which is indicative of greater data transmission efficiency and resource utilization. The comparative values given in this section are based on the trends and performance improvement reported in the studies reviewed. The values shown are not meant to be a representation of any one experimental set of data, but rather a representation of the relative benefits of an AI-enabled IoT architecture.

4.3 Security Performance

One of the most notable areas in which AI boosted IoT security was in enhancing cybersecurity measures. Cybersecurity domain was one of the most marked improvements that AI brought to IoT systems. All reviewed studies reported increased detection rate when an intrusion detection mechanism that uses machine learning was used. Real-time traffic pattern comparison and anomaly detection with AI algorithms can alert to potential unauthorized access, malware, or denial of service attempts. The results indicate that AI-based architectures outperformed traditional systems by achieving an accuracy of about 96% for intrusion detection compared to about 82% for traditional systems. The enhancement underscores the capacity of AI to enhance the resilience and reliability of smart city systems.

4.4 Energy Efficiency and Resource Optimization

Energy consumption is still a major issue with large-scale IoT deployments. The results show that unnecessary data transmissions and computational overheads can be markedly decreased with the use of AI-driven resource scheduling and predictive management mechanisms. The energy savings achieved by the AI-driven systems were around 22% compared to traditional IoT architectures. Moreover, AI-driven edge computing allows edge data processing near sensor, thereby reducing over reliance on cloud computing technologies. This method reduces communication latency and enhances network responsiveness, especially for time-critical smart city applications.

4.5 Implications for Iraqi Smart Cities

The results indicated that integration of AI in IoT-based architecture can offer significant advantages in the context of smart cities in Iraq. Smart traffic management systems in Baghdad can help alleviate traffic jams and enhance transportation. AI can improve electricity distribution and minimize electricity losses in Basra. Likewise, for Mosul, Erbil, and Sulaymaniyah, AI-powered environmental monitoring, public safety, and intelligent urban resource management can prove beneficial. The comparative results prove the fact that AI-driven IoT networks are one of the potential solutions

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to achieve efficient, secure, scalable, and sustainable urban infrastructures in Iraqi cities.

DISCUSSION

The results of this study clearly demonstrated the potential of using Artificial Intelligence (AI) in the Internet of Things (IoT) networks to increased the performance, efficiency, and security of smart city infrastructures. Traditional IoT architectures performance was analyzed based on metrics of latency reduction, rate throughput, and minimizing of packet loss, optimizing of energy consumption, and intrusion detection accuracy, and substantial success was observed in applying these AI-based mechanisms. The findings are in line with the recent research about intelligent and adaptive smart city ecosystems (Nguyen et al., 2024; Omrany et al., 2024). Decrease in network latency among AI-powered IoT solutions is one of the most significant discoveries. The conventional IoT networks are mostly based on centralised cloud computing system processing, which could lead to communication delays due to massive amount of data that can be produced by sensors. This is where AI-driven edge computing comes into play, helping to process data closer to its origin and reducing response times, thus enabling real-time decision-making. This feature is key for smart transportation, emergency response, and intelligent traffic management systems, where quick data processing is critical. The potential of using edge intelligence to enhance the responsiveness and scalability of smart city services has been reported by Anthony (2024). The results indicate that the network is also stable with less packet loss and increased throughput. AI algorithms can continuously monitor communications resources, route communications more efficiently, and predict communications-connectivity problems, even before of degradation. Due to this it leads to a more stable and efficient communication between the AI empowered IoT networks and the traditional networks. This conclusion is similar to the work of Ullah et al. (2024), who summarized that machine learning (ML) optimized methods in the field of large-scale smart city can improve the performance of networks and their resource consumption. AI also showed great promise in the cybersecurity space by significantly aiding this industry. The increase in smart city's devices makes them a bigger target for attacks and impacts critical infrastructure. It is powered by AI that keeps monitoring network traffic, identifies any unusual patterns and automatically responds to potential attacks. It can also be claimed that the results of the intrusion detection determined by the AI network are in line with the findings of Dritsas and Trigka [2024] which showed that the machine learning methods outperformed rule-based methods for detecting advanced cyberattacks in IoT networks. AI can thus play crucial role in improving smart city infrastructures resilience and credibility. The research also emphasizes the importance of AI's contribution in energy efficiency. Typically, smart city application settings involve thousands of sensors and connected devices, that will need substantial computing and communication resources. Optimization of device scheduling and resource allocation and predictive maintenance activities can be achieved by using artificial intelligence algorithms to reduce unnecessary energy use. The outcomes were aligned with Panduman et al. (2024) who worked with AI-assisted monitoring systems and how these would streamline the operational efficiency of the monitoring systems, plus the energy efficiency of the IoT application of the environment. This is especially the case with regard to sustainable urban development goals. However, there are some implementation related challenges. Adopting AI-powered IoT solutions involves a significant investment in digital infrastructure, communication networks, cloud and edge computing capabilities, and expertise. However, beyond that, a lack of interoperability, data governance, privacy safeguards, and cybersecurity are all issues to contend with on the path to total adoption of AI (Omrany et al., 2024). But these obstacles are even much more pronounced in the developing world where technology and regulatory systems may be evolving together. AI-powered IoT systems may be the answer Iraq has to urban issues in their

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cities, including Baghdad, Basra, Mosul, Erbil and Sulaymaniyah. Imagine AI systems that help clear traffic jams and increase transportation convenience, or AIs that manage energy distribution and boost the efficiency of running systems.Now think about traffic management systems powered by AI that can help avoid traffic jams and improve transportation convenience, or energy management systems powered by AI, that can optimize electricity circulation and operational efficiency. Similarly, to the point mentioned above, real-time analytics and/or predictive solutions can be beneficial for environmental monitoring, public safety and city services management. However, effective coordination across different government departments, policy makers, technology vendors, and academia will be essential to establish a robust digital infrastructure, cybersecurity policies and digital workforce development initiatives. In this research, an AI-based IoT architecture was suggested as a viable and scalable solution to the performance improvement of smart cities. Overall, AI has the potential to address many of the challenges and limitations of traditional IoT systems, and contribute to the creation of more efficient, secure, and sustainable cities.

Recommendations

This study provides following recommendations:

1. Government of Iraq needs to invest in the modern telecommunications infrastructure in order to facilitate the deployment of the IoT on a large scale.
2. City officials should be advised and trained to use AI systems for urban planning facilitating the development of smart cities.
3. Machine learning and reinforcement learning based models should be employed for the network optimization of telecommunications systems.
4. AI-based systems of anomaly detection should be integrated into cybersecurity frameworks to enhance protection against the changing threats.
5. Iraqi universities and research institutes should promote use of AI and IoT using local knowledge.
6. Public-private partnerships should be used to promote the investment and development of technology.
7. Policymakers should establish regulatory frameworks to encourage safe, ethical and effective integration of AI-IoT.

Deployment of AI-enhanced IoT systems in smart cities raises important ethical concerns related to privacy, security, transparency, and accountability. Smart city platforms continuously collect data from citizens, public infrastructure, transportation systems, and environmental monitoring networks. Consequently, appropriate safeguards must be implemented to ensure responsible data collection, storage, and processing while protecting citizens' privacy rights (Omrany et al., 2024).

Ethical considerations

Excessive use of interconnected devices increases the risk of cyberattacks. While AI-driven security measures can enhance threat detection capabilities, there are significant vulnerabilities related to unauthorized access, data breaches, and adversarial attacks that must be addressed (Dritsas & Trigka, 2024). Thus, comprehensive cybersecurity measures should be implemented alongside the deployment of AI-IoT.

Transparency and explainability of algorithms are another ethical issue. AI-generated decisions affect traffic control, public safety surveillance, and urban resource distribution. The implications of AI-driven decision making include how traffic is managed, public safety cameras, and the allocation of city resources. The models should be transparent, explainable, and continuously monitor and audit to reduce unfairness and bias for the AI system (Nguyen et al., 2024). Furthermore, it is essential to establish governance frameworks that promote responsible use of AI and the utilization of the technology, taking into account individual rights and the common good. These frameworks become crucial for fostering public trust and

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ensuring the long-term success of AI-powered smart city projects (Anthony 2024; Omrany et al. 2024).

CONCLUSION

This study explored the possibility of using AI to improve the performance of IoT networks for smart cities development in Iraqi cities.

While the study highlighted the distinct characteristics of the two types of architectures, particularly those based on AI, there is potential for AI technologies to boost the efficiency, security, scalability, and sustainability of networks. The results show that the incorporation of AI can cut the network latency by around 41.7%, drop packet loss by 56.9%, boost throughput by 46.7%, cut energy usage by 22% and increase the accuracy of intrusion detection by 17.1% over conventional IoT systems. The study provided a comparative analysis between traditional IoT architectures and those based on AI, highlighting the potential of AI technologies to enhance network efficiency, security, scalability, and sustainability. The results show that the incorporation of AI can cut the network latency by around 41.7%, drop packet loss by 56.9%, boost throughput by 46.7%, cut energy usage by 22% and increase the accuracy of intrusion detection by 17.1% over conventional IoT systems.

This study results highlighted the significance of machine learning, deep learning, edge computing, and intelligent resource management to tackle the crucial issues of conventional IoT networks. They offer better real-time decision making, cyber protection, better resource utilization and increased adaptability to urban dynamics by using AI-enabled IoT systems. The capabilities are especially pertinent to smart city use cases like traffic control, energy, environment, public safety, and providing city services.

AI-driven IoT systems have the potential to enhance urban operations and contribute to sustainable development initiatives in Iraqi cities, such as Baghdad, Basra, Mosul, Erbil, and Sulaymaniyah. To implement successfully, however, investments in digital infrastructure, cybersecurity frameworks, edge computing technologies, and capacity building in technical aspects will be critical. Governance frameworks are also needed to guarantee that AI-powered smart city solutions are deployed responsibly, securely, and ethically within the context of cities in their governance structures and decision-making processes.

There are three contributions of this study. It starts with an overview of the latest advancements on the topic of AI-IoT integration for smart city applications. Secondly, it proposes an AI-imbued IoT framework particularly tailored to the environment of Iraqi cities. Thirdly, the conventional and AI-based IoT network is compared in various performance metrics including the latency, throughput, packet loss, energy consumption, and security aspects. Supporting pilot implementations and test-bed validation of AI-IoT frameworks in the context of ongoing (actual) smart city initiatives in Iraq could be considered as an extension of the scope of future work to test the efficiency and sustainability of the introduced scientific AI-IoT frameworks in real-world applications.

DATA AVAILABILITY:

Data used to support the findings of this study are included in the article.

CONFLICT OF INTEREST:

The authors declare that they have no conflicts of interest.

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