

## INNOVATIVE TECHNOLOGIES IN SMART CITIES: EXPERIENCE AND PROSPECTS

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### Анотація

*Стаття досліджує інноваційні технології, впроваджені в рамках концепції розумних міст, аналізуючи їхній вплив на покращення міської інфраструктури та якості життя громадян. Розглядаються ключові технології, такі як Інтернет речей (IoT), штучний інтелект (AI) та інформаційно-комунікаційні технології (ІКТ), а також їхнє застосування в управлінні міськими ресурсами та послугами. Особлива увага приділяється досвіду впровадження цих технологій у різних містах світу та перспективам їхнього подальшого розвитку.*

**Ключові слова:** розумне місто, інноваційні технології, Інтернет речей (IP), штучний інтелект (ШІ), інформаційно-комунікаційні технології, міська інфраструктура.

### Abstract

*The article explores innovative technologies implemented within the concept of smart cities, analysing their impact on improving urban infrastructure and citizens' quality of life. Key technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), and Information and Communication Technologies (ICT) are examined, along with their application in managing urban resources and services. Special attention is given to the experience of implementing these technologies in various cities worldwide and the prospects for their future development.*

**Keywords:** smart city, innovative technologies, Internet of Things (IoT), Artificial Intelligence (AI), Information and Communication Technologies, urban infrastructure.

### Introduction

The development of modern technologies significantly impacts urban centres, transforming them into smart cities. This concept involves integrating advanced technologies to enhance the efficiency of urban resource management, improve the quality of life for residents, and ensure sustainable development. This article examines the main innovative technologies applied in smart cities, their impact on urban infrastructure, and prospects for further development.

### Main part

The Internet of Things (IoT) is one of the key technologies enabling interaction between various devices and systems in the urban environment. Thanks to IoT, cities can collect and analyse data in real time, optimizing resource management and improving service delivery to citizens. The implementation of this technology allows city services to respond promptly to changes and introduce effective solutions to enhance infrastructure and residents' comfort [1].

One of the key applications of IoT in smart cities is smart lighting. This technology involves using sensors that automatically adjust street lighting intensity based on the time of day, weather conditions, and the presence of pedestrians or vehicles. Such systems significantly reduce energy consumption, contributing to municipal budget savings and reducing CO<sub>2</sub> emissions into the atmosphere. Some cities have already implemented smart streetlights that can dim during low-activity periods and brighten again when people or vehicles are nearby.

Another important application is infrastructure monitoring, which involves installing sensors on buildings, roads, bridges, and other urban infrastructure objects [2]. These sensors collect information about the condition of structures, material wear levels, vibrations, and other critical parameters. With such monitoring, city services can detect problems in time, prevent emergencies, and optimize repair costs. For example, special sensors on bridges can signal the appearance of cracks or changes in vibration patterns, helping to prevent potential collapses and enhancing safety.

A crucial aspect is also transportation management using IoT. Intelligent transportation systems use sensors to monitor traffic flow, analyse street congestion, and control traffic lights. These systems help optimize traffic, reduce congestion, and shorten travel times for both public and private transport. For instance, many smart cities have introduced adaptive traffic lights that adjust their operation based on real-time traffic conditions, helping to lower air pollution and save fuel. Additionally, GPS trackers in public transportation allow passengers to receive real-time information about bus or tram arrivals, improving the convenience of using public transport services.

Overall, the implementation of IoT in smart cities enhances resource management efficiency, improves safety, and creates a more comfortable environment for residents. The further development of this technology will allow for even greater optimization of urban infrastructure, making cities more eco-friendly and livable [3].

Artificial intelligence (AI) plays a vital role in analysing large volumes of data collected via IoT and making informed decisions to improve urban processes. The application of AI in smart cities includes demand forecasting, traffic management, and security. Demand forecasting involves analysing data to predict energy, water, and other resource consumption, optimizing their use and reducing costs [4]. Traffic management utilizes AI to analyse traffic data and adjust traffic light operations, helping to reduce congestion and enhance road safety. Security involves using facial recognition systems and behaviour analysis to improve public safety and enable quick responses to emergencies.

Information and communication technologies (ICT) ensure efficient interaction between city services and citizens, promoting transparency and operational management. Examples of ICT applications in smart cities include e-services, feedback platforms, and management information systems [5]. E-services provide citizens with access to administrative services online, reducing bureaucratic obstacles and increasing convenience. Feedback platforms involve developing mobile applications and web portals for reporting urban issues, allowing authorities to respond quickly to citizens' concerns and improve the city environment. Management information systems use ICT to coordinate city service operations, plan infrastructure development, and monitor project implementation.

## Conclusion

Innovative technologies play a key role in the development of smart cities, contributing to more efficient resource management, improved quality of life, and environmental sustainability. The implementation of IoT, AI, and ICT enables the optimization of transportation, enhances security, and creates a more comfortable urban environment. In the future, the advancement of these technologies will further modernize urban infrastructure and establish new standards for urban living.

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