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AI-Enhanced Strategies for Energy-Efficient Urban Environments

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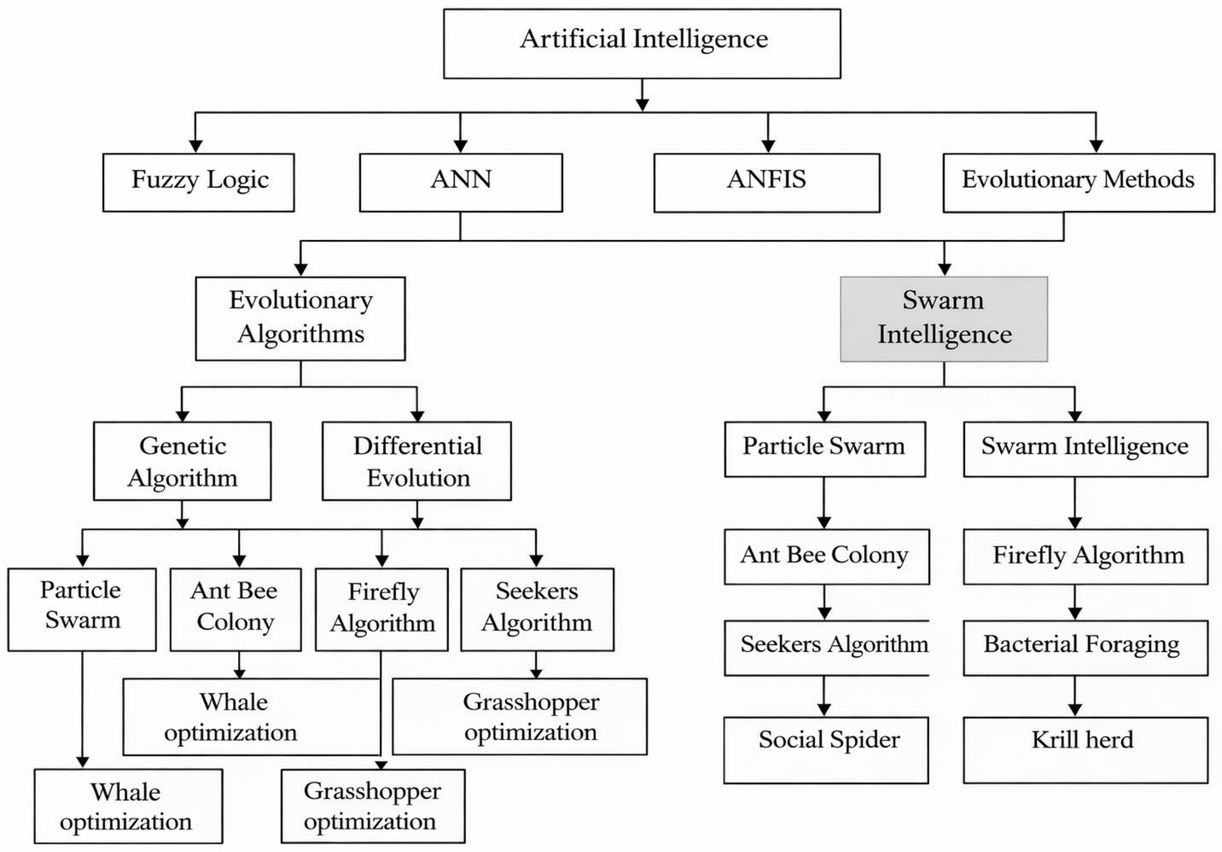
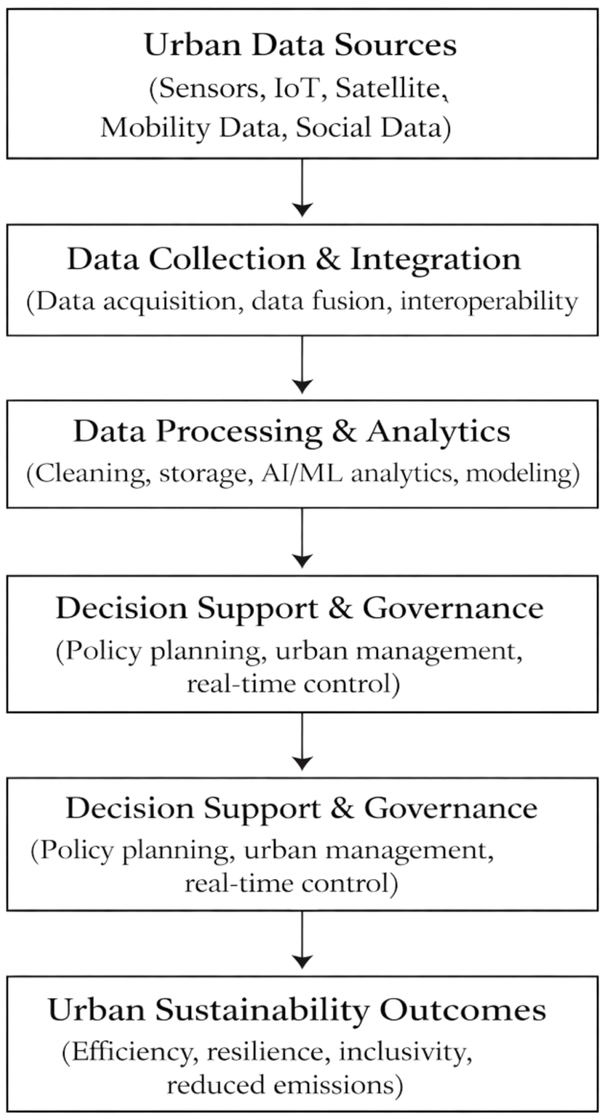
INTRODUCTION & AIM

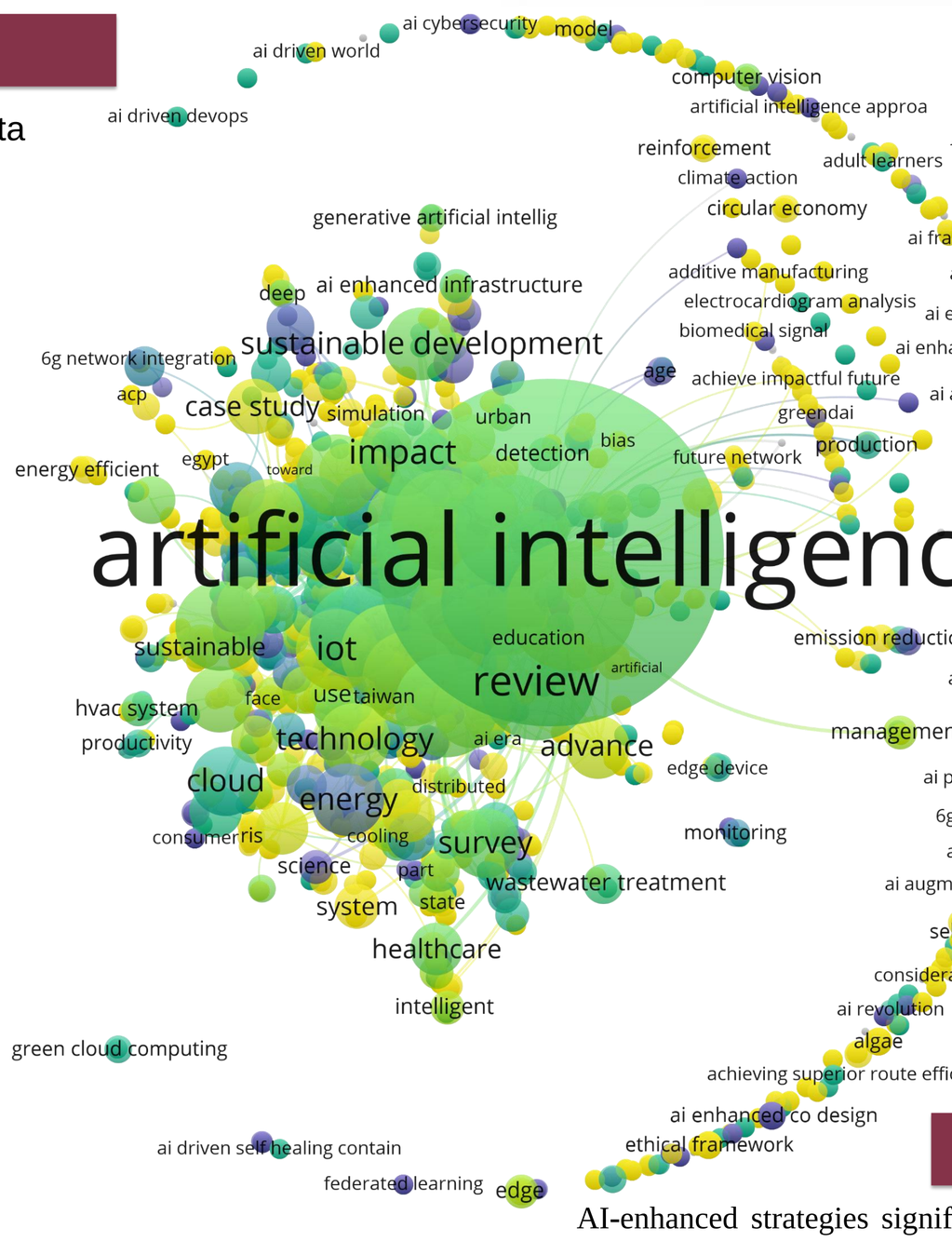
The problem of rapidly growing population, the accelerated use of resources, and the urgent necessity to ensure the sustainability of the environment puts an increasing burden on urban settings, and that is why energy efficiency becomes the burning issue of the modern city development. Artificial intelligence (AI) has become a game-changing technology, dealing with these issues by making the process of energy management smarter with more sophisticated data analytics, predictive models, and real-time optimization. With Internet of Things (IoT) sensors and cloud computing to complement AI approaches, they can be used to control dynamically the use of energy in various urban infrastructures, such as buildings, transportation systems, and smart grids, and thereby eliminate a significant share of waste and carbon footprints. Machine-learned models are also more effective in forecasting electricity consumption by modeling complex interactions between the environment and energy demand which, in turn, serves to assist in better urban energy planning and policy formulation. Moreover, AI-based digital twins generate virtual model copies of urban systems which enable constant tracking and optimization of energy circulation, which supercharges sustainability initiatives at the level of cities. However, along with these encouraging developments, such issues as data integration, model interpretability, and the compatibility of resident comfort and efficiency are still aspects that the research should focus on to capitalise on the potential of AI to achieve energy-efficient urban environments.



Urban Data Ecosystems

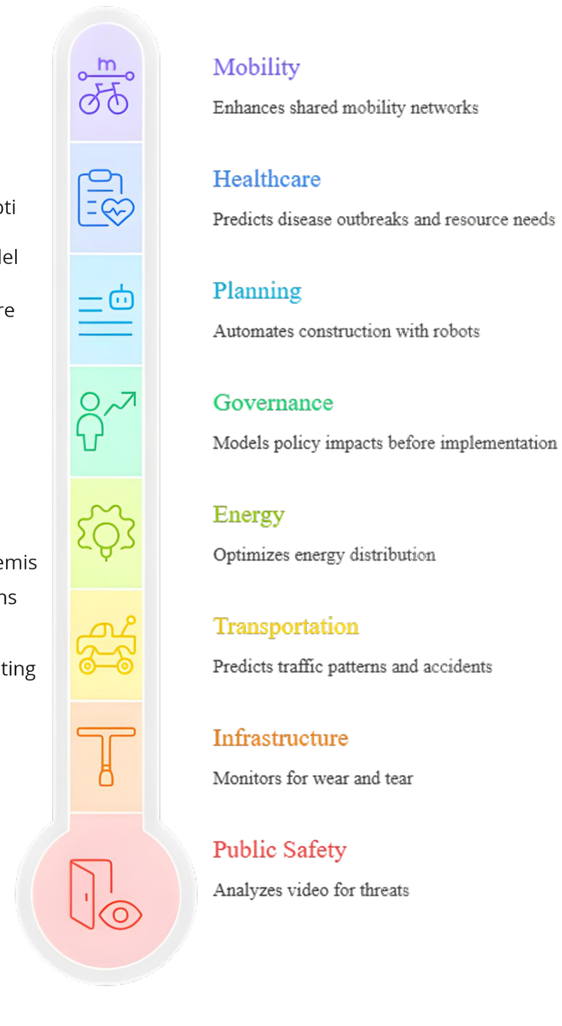
Methodological Framework for Urban Data Ecosystems:





AI Application in Urban

AI-Driven Application Domains in Smart Urban Systems.



AI-Based Optimization Techniques

AI-based optimization techniques leverage machine learning (ML) to enhance energy efficiency in buildings and integrated energy systems by accurately predicting demand and controlling operations. Supervised learning uses labeled data with algorithms like support vector machines and random forests to forecast energy use and optimize HVAC systems. Unsupervised learning identifies patterns and anomalies in unlabeled data, aiding fault detection and adaptive maintenance. Deep learning architectures such as convolutional and recurrent neural networks capture complex spatial-temporal dependencies for improved prediction and real-time control. Hybrid models combine physics-based knowledge with ML to increase reliability and interpretability in energy simulations. Additionally, Internet of Things (IoT) devices provide real-time sensor data that feed ML algorithms for dynamic monitoring and optimization, enabling responsive energy management across urban infrastructures.

CONCLUSION

AI-enhanced strategies significantly improve energy efficiency in urban environments by integrating advanced machine learning, deep learning, and hybrid models with real-time data from IoT and sensor networks. These approaches enable accurate forecasting of energy demand, dynamic optimization of consumption, and fault detection, leading to reduced waste and cost savings. AI drives green technological innovation and industrial restructuring, which are key mechanisms for enhancing urban energy efficiency, especially in cities with strong environmental regulations and digital infrastructure. Smart building applications using AI-powered energy management systems demonstrate substantial reductions in electricity bills and improved grid stability.

REFERENCES

1. Bibbò, L.; Laganà, F.; Bilotta, G.; Meduri, G.M.; Angiulli, G.; Cotroneo, F. AI-Enhanced Eco-Efficient UAV Design for Sustainable Urban Logistics: Integration of Embedded Intelligence and Renewable Energy Systems. Energies 2025, 18, 5242, doi:10.3390/en18195242.