

Planning and Design Challenges for AI-Enabled Digital Twin in Smart Cities

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Abstract : The planning and design of smart cities increasingly demand advanced support systems driven by cutting-edge digital technologies. Among these, Digital Twin technology has emerged as a promising tool for facilitating digital transformation and enhancing decision-making across various sectors, including urban planning. Concurrently, rapid advancements in artificial intelligence (AI) have significantly influenced sustainable city planning and community development, driving the rise of a post-smart urban planning trajectory through the integration of advanced AI systems. However, the integration of AI and Digital Twin technologies in urban planning remains underexplored, with a limited understanding of their combined potential and associated challenges. This study aims to critically examine how AI-enabled Digital Twins can transform smart cities and identify the key challenges hindering their implementation. Through a systematic literature review complemented by scientometric analysis, this research provides a comprehensive overview of the current state of the art, emerging trends in adopting AI-driven Digital Twins, and the critical barriers to their deployment in urban environments. The findings reveal that AI-enabled Digital Twins offer significant potential to enhance smart city design and planning by improving decision support systems, data processing capabilities, automation, predictive modeling, simulation, stakeholder engagement, and citizen participation. However, the study also highlights substantial implementation challenges, including concerns over feasibility, data privacy, technical expertise, and governance frameworks. This research contributes to the academic discourse by offering valuable insights for researchers, policymakers, and urban planners. It underscores how the integration of AI and Digital Twin technologies can drive the evolution of smart cities while providing a clear understanding of the multifaceted challenges that must be addressed to realize their full potential.

Keywords : artificial intelligence, digital twin, smart cities, implementation challenges

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