Smart Urban and Rural Development with Digital Twins and GIS

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***ABSTRACT***

In the quest to enhance urban and rural development, the application of cutting-edge technologies has become pivotal. This study introduces an innovative methodology that integrates deep learning, photogrammetry, GIS, drone technology, and LiDAR to transform urban infrastructure management and planning. Emphasizing the need for smart city solutions, this research delves into real-time actionable insights and predictive maintenance facilitated by the integration of Building Information Modelling (BIM) and Digital Twins. By harnessing data from sensors and IoT devices, the approach offers dynamic mapping and predictive analytics of city conditions, ensuring timely interventions. Key to this study is the creation and utilization of digital twins, which are instrumental in urban and archaeological planning. Leveraging high-resolution drone imagery, LiDAR data, and GNSS technology, the research enables accurate boundary mapping and the development of detailed 3D models. The use of Interferometric Digital Detection Method (IDDM) imaging, combined with laser-equipped drones, provides exceptionally high-resolution topographic data, essential for generating precise digital elevation models and 3D maps. Real-time processing of aerial imagery through distributed computational networks and federated learning enhances the accuracy and reliability of urban models. Additionally, the integration of scalable vector mapping systems with advanced routing algorithms improves navigational precision and operational efficiency. This study highlights how these technologies can be employed to address immediate urban planning challenges, demonstrating their potential in optimizing development strategies and adapting to evolving city dynamics.

**Keywords:** smart city, BIM, Digital Twins, drone technology, LiDAR, real-time analytics, urban development, IDDM, GNSS