Smart Building, Smart Community, and Smart City Digital Twins

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Digital twins are intelligent adaptive systems that pair virtual and physical worlds using iterative data-driven feedback loops. This information connectivity combined with analytics and virtualization allows for the creation of a "smart" digital twin of a building (to include residential, commercial, factories, etc.), a community (to include neighborhoods, corporate campuses, military installations), and a city. These IoT-enabled, data-rich virtual platforms, are used to progressively inform decision makers by dynamically simulating changes, through integration of cyber-physical infrastructures that are embedded with information about the dynamics of infrastructure processes, environmental qualities, and human activities, as well as adaptation to changing conditions, to improve a city's resilience, sustainability, and livability [1].

In this Minitrack, we establish the theoretical and scholarly foundation for the development, predictive analytics, and adaptive capabilities of Smart Buildings, Smart Communities, and Smart City Digital Twins. A paradigm that enables increased visibility into human-infrastructure-technology interactions involving policy elements through learning, analytics and exchange of spatiotemporal data with particular emphasis on the following topics:

- Theories, Models, and System Architecture for Smart Buildings, Smart Communities, and Smart City Digital Twins.
- Scaling Digital Twins from Single Infrastructure Systems to Multiple Interdependent Systems.
- Data, Sensing Modalities, IoT, and Analytics for Smart Buildings, Smart Communities, and Smart City Digital Twins.
- Human-Infrastructure Interdependencies, Connectivity, and Community Engagement.
- Information Modeling, Management, and Decision Support for Digital Twins.
- Digital Twin Virtualization (Virtual Reality / Augmented Reality / Mixed Reality).
- Implications for Operational Readiness, Context-Aware Simulation, and Crisis Management.

Leveraging recent innovations enabled by information communication technology (ICT), many city governments around the world are exploring ways to achieve improved quality of life for their citizens. However, siloed implementations of smart technology can quickly hinder meeting the objectives of such investments. Decision makers thus require an enhanced ability to model, understand, and anticipate the operational dynamics across human, infrastructure, and technology systems collectively. Enabling simulation of iterative stakeholder-led *what if* scenario generation and prediction of desired and/or undesired future conditions, such Digital Twins can help analysts and decision makers perceive interdependencies, anticipate emergent behavior, understand how buildings, communities and cities equipped with smart technologies will likely perform under various conditions, and identify the drivers of possible disruptions.

Smart Building, Smart Community and Smart City Digital Twins are complex and require new technological and methodological advancements and collaborative participation across disciplines. Papers featured in this HICSS-54 minitrack range in foci from computer vision-based Smart City Digital Twins for monitoring and forecasting collective urban hazard exposures of communities, to creating digital replicas of aggregate human-infrastructure interaction behaviors, such as daily human mobility patterns, based on the spatial distribution of local infrastructure. These studies highlight the recent discoveries in this area of and aim at expanding the scientific capacity to integrate Smart Building, Smart Community and Smart City Digital Twins research and practice in response to societal needs and challenges, and represent a critical step forward in operationalizing living digital replicas of cities.

References

[1] Mohammadi N, Taylor JE. Smart City Digital Twins. IEEE Symp. Ser. Comput. Intell., 2017. doi:10.1109/SSCI.2017.8285439.

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