D7 - Interactive Visual Analytics for Campus Digital Twin

COA SHOWCASE

Digital Twins (DTs) are increasingly recognized as powerful tools for enhancing efficiency and decision-making in various domains of the built environment. By replicating and simulating real-world systems in a digital environment, DTs offer immense potential for optimizing operations, improving resource management, and enabling data-driven planning. Despite their growing relevance, several challenges impede their wider adoption. These include high costs, implementation complexity, interoperability issues, and the difficulty of integrating diverse data sources into a cohesive model. This demo introduces an innovative interactive visual analytics system designed to overcome these challenges. Using a case study focused on the simulation of class distribution and campus building capacity at Texas A&M University, we showcase how DTs can be applied to optimize spatial and temporal resource management in an educational setting. The system transforms enrollment data into a spatial-temporal format, enabling users to interactively explore and analyze class distribution, resource utilization, and capacity constraints. This allows decision-makers to visualize trends, identify inefficiencies, and make informed adjustments to optimize building use and scheduling. One of the key features of this system is the integration of visual analytics within the DT framework, providing an accessible and user-friendly interface that enables stakeholders, regardless of technical expertise, to engage effectively. This adaptability ensures that the insights generated can be easily understood and acted upon by a diverse range of users. The case study at Texas A&M University demonstrates the system's ability to address real-world challenges, such as overcrowded classrooms and underutilized spaces. It offers a practical approach to DT implementation in educational environments, bridging the gap between complex data-driven technologies and their real-world applications. Our findings suggest that DTs, combined with interactive analytics, have the potential to significantly improve the management of built environments, making them more efficient, responsive, and adaptable. This research contributes to the growing field of DTs and offers a roadmap for overcoming the current limitations in this emerging area.