

Generation and Web-Based Visualization of HBIM Models from Point Cloud and Photogrammetric Data

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Abstract

Digital transformation has significantly advanced the field of architectural documentation through the integration of Building Information Modelling (BIM) technologies, enabling more efficient, data-driven approaches for the three-dimensional documentation of historical structures and sites. In the field of cultural heritage management and conservation projects, the adoption of Historic Building Information Modelling (HBIM) offers substantial potential for improving efficiency due to its various operational and technical advantages. In this respect, this study aims to generate HBIM from point cloud data of cultural heritage structures and present the resulting model through a web-based digital twin approach. The Temple of Jupiter in Pompeii, Italy, and the Seu Vella Cathedral in Lleida, Spain, were selected as case studies due to their different architectural and historical characteristics. HBIM models were generated using the point cloud data as the primary geometric reference and were structured according to the Industry Foundation Classes (IFC) standard to facilitate interoperability and long-term data sustainability. Model data consistency was evaluated by comparing measurements obtained from the point cloud and the HBIM model in horizontal and vertical directions. Quantitative accuracy was assessed using statistical performance indicators, including mean difference, mean absolute error, and root mean square error. The results indicate that point-cloud-based HBIM is an effective approach for digital documentation and sustainable archiving of cultural heritage. Additionally, the models were presented as a web-based digital twin archive, and an AI-based chatbot was integrated to enhance user engagement, accessibility, and interactive exploration of the heritage data.

Keywords: HBIM, Point Cloud, Cultural Heritage, Preservation