AI Framework for Scan to BIM Automation for UK`s Cultural Heritage

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1. Background and problem

This research explores the practical implications of integrating advanced AI technologies in HBIM, highlighting how these can alleviate the substantial manual effort traditionally required in data acquisition and processing. By automating critical aspects of HBIM, such as point cloud classification and 3D model generation, this research sets a new standard for efficiency and accuracy in the field. The findings from this research not only pave the way for resolving critical bottlenecks in HBIM practices but also enhance the efficiency of 3D HBIM model generation, significantly contributing to the preservation of architectural heritage.

It aims to propose the "AI4HBIM.UK Framework," an innovative guide for applying AI solutions to the challenges of building revival, restoration, restitution, retrofit, and resilience. Our research thoroughly investigates AI's role in automating the generation and segmentation of HBIM geometries from point cloud data, a process previously noted for its laborious and error-prone nature.

2. Research Methodology

The methodology encompasses a comprehensive semi-structured literature review and employs design science research for experimental validation and framework development using the cultural heritage case study data from Royal Greenwich Museum in the UK.

Various AI techniques, including RANSAC, DBSCAN, Random Forest, and Deep Neural Networks, are critically evaluated for their efficacy in classifying and segmenting complex building geometries. These methods are intricately tested through a series of experiments that focus on enhancing the accuracy and detail in HBIM projects, addressing challenges like complex geometry representation, data integration, and the interoperability of heritage data with modern digital tools.

3. Value and Contribution

Significantly, this research integrates these AI techniques into a bespoke workflow utilizing Autodesk Revit API and Dynamo, showcasing substantial improvements in automating HBIM processes. The AI4HBIM.UK Framework developed here provides detailed protocols and strategies, addressing several key HBIM challenges such as standardization of methodologies, enhancing data quality, and ensuring software interoperability within heritage conservation projects.

This research advances the integration of artificial intelligence (AI) in Heritage Building Information Modelling (HBIM), focusing on overcoming prevalent challenges in data acquisition, geometry processing, and model accuracy essential for the conservation and management of cultural heritage buildings.

The research concludes with recommendations for future research, particularly in further developing AI applications within HBIM to cover broader aspects of heritage building management and conservation.