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Chair of Computational Modeling and Simulation

An AHP-TOPSIS-based approach for similarity analysis of building designs

Topic Description

A powerful building design support system can not only meet the design requirements but also automatically recommend the appropriate alternatives for designers, but most comparisons and modifications now are conducted in the manual way.

This thesis is dedicated to the development of an innovative prototype/dashboard that leverages the Analytic Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) methodologies for the comparative analysis of building designs. This approach is poised to offer a comprehensive evaluation of architectural building designs, aiding in decision-making processes. The prototype aims to provide a user-friendly interface that enables architects and planners to efficiently compare different designs.

Keywords

BIM, Design Similarity Metrics, Design Decision-Making, AHP, TOPSIS

Method Description & Tasks

The research revolves around integrating the AHP and TOPSIS approaches in design decision-making. These methods are fundamental in multi-criteria decision-making, aiding in complex problems with multiple criteria that are often challenging to quantify. The combination of AHP's hierarchical structuring and consistency ratio with TOPSIS's ideal solution comparison provides a comprehensive approach for design similarity evaluation.

The thesis will focus on both the spatial and semantic ascpects of the building design, e.g., the building layout, interal accessibility and fire-resistance features. In this regard, the integration of AHP and TOPSIS methods will provide a systematic comparison approach between building designs, helping professionals make informed decisions based on selective criteria, including code compliance related requirements.

The thesis will encompass several essential tasks, including:

- Conducting an extensive literature review to
  - o explore and categorize design similarity metrics from architectural standpoints.
  - o Investigate the state-of-the-art of the AHP and the TOPSIS methods.
- Implementaing the approach for building design comparison.
- Developing an interactive dashboard as user interface for customized visualization of the results.

Programming requirements

- A solid grounding in object-oriented programming experiences with Python
- Experience in Frontend techniques (HTML, CSS, JavaScript)

Implementation Basics

The practical component of the thesis involves developing a system with specific technical requirements, including:

- Integration with BIM and OpenBIM Models: accessing and extracting data from BIM authoring tools (notably Revit) and OpenBIM models, specifically using the IFC format.
- Application of AHP-TOPSIS Algorithms: implementing the Analytic Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) algorithms. These algorithms will be used for evaluating design similarities in an objective and comprehensive manner.
- Development of an Interactive Dashboard: constructing a user-friendly dashboard for customized queries and results.

Prospective Outcomes

Upon completion, the thesis is expected to yield a practical method that significantly contributes to the field of BIM-based design similarity and decision-making with the following components:

- A Data Exportor for Authoring BIM / Open BIM models
- Algorithm developememt for the AHP-TOPSIS approach
- An user-friendly dashboard for the similarity analyses

Supervision

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Supervision mode:

- Thesis kick-off meeting, Weekly progress exchange;
- Intermediate thesis meeting;

References

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