WIP

**Research Paper: Enhancing Architectural Visualization and GIS Feedback through Real-Time Data Integration and Advanced Simulations**

<https://github.com/ronmaccms/macadThesis24>

Traditional architectural tools often fall short in providing real-time, site-specific data, which hampers informed decision-making. This research proposes to develop a web-based platform that integrates real-time GIS data with advanced simulations to enhance architectural visualization and decision-making processes in the AEC industry.

The objective is to develop a web-based platform to enhance architectural visualization and GIS feedback using real-time data and advanced simulations. This platform will provide efficient access to site-specific data and visualizations, facilitating informed decision-making during architectural discussions.

We aim to develop a comprehensive web-based platform integrating real-time GIS data with advanced simulations, providing valuable tools for architects, urban planners, and other stakeholders. The project seeks to bridge the gap between traditional architectural visualization tools and the need for real-time, detailed site-specific information, ultimately improving decision-making processes in the AEC industry.

**Platform**

To address the challenges faced in the AEC industry by providing a tool that enhances the accuracy and accessibility of site-specific data, thereby improving the quality of architectural and urban planning decisions.

Functions:

1. Real-Time Integration:
   * Integrates GIS data provide detailed, site-specific information.
   * Tools to analyze the topography of a site, including elevation, slope, and landform features.
   * Real-time environmental data such as weather conditions, vegetation cover, and soil types.
2. Advanced Simulations:
   * Uses GNNs to simulate various scenarios, such as land use classification, environmental impact assessments, and urban growth predictions.
   * Allow users to interact with and analyze the integrated data in a meaningful way.
3. Architectural Visualization:
   * Compares latest LIDAr google earth topography with GIS data.
   * Allows architects and planners to run different scenarios to understand potential impacts and outcomes (maybe - flood?).

Why:

* By providing accurate open source, and comprehensive data, the platform helps stakeholders make more informed decisions.
* Streamlines the process of gathering and analyzing site-specific information, saving time and resources.
* Supports sustainable development practices by enabling detailed environmental impact assessments and promoting data-driven decisions.

**Research Methodology:**

1. Data Acquisition and Processing:
   * data sources relevant to the project (e.g., OSM, government databases, google tiles).
   * Ensure data accuracy and relevance through processing?
2. Platform Development:
   * Develop a prototype focusing on data integration, real-time updates, and basic visualization tools.
   * Use Vue.js for the front-end and serverless architecture for the backend.
3. Integration of Real-Time Data:
   * Start with one or two real-time data sources (e.g., Google Maps tiles and LiDAR).
   * Develop APIs for data fetching and updating?.
4. AI Model and Advanced Simulations Deployment:
   * Begin with a single AI model for a specific task and integrate MeshGraphNet for simulations.
   * Deploy the model as a REST API and integrate it into the platform.
5. Data Visualization:
   * Implement basic visualization features like zooming, panning, and selecting data points.
   * Use QGIS for detailed desktop-based analysis.

**Timeline for 2.5 Months**

Week 1-2: Initial Setup and Data Acquisition

* Finalize project scope and objectives david.
* Identify and acquire relevant geospatial datasets.
* Set up the development environment (Vue.js, AWS Lambda/Google Cloud Functions).

Week 3-4: Core Platform Prototype

* Develop the front-end using Vue.js.
* Implement the backend for basic data handling.

Week 5-6: Real-Time Data Integration

* Develop APIs for one real-time data source.
* Implement data fetching and updating mechanisms.

Week 7-8: AI Model Deployment

* Train and deploy a simple AI model for a specific geospatial analysis task.
* Integrate the AI model as a REST API.

Week 9-10: Simulation Integration

* Implement MeshGraphNet for a basic simulation use case.
* Ensure simulation results are integrated into the platform.

Week 11-12: Data Visualization and Testing

* Develop basic visualization tools.
* Ensure compatibility with QGIS.
* Test and refine the platform.

Week 13-14: Finalization and Documentation

* Finalize the platform with integrated features.
* Prepare documentation and a proof of concept.

**Expected Deliverables**

* A functional web-based platform prototype.
* Demonstration of real-time data integration, advanced simulations, and visualization capabilities.
* A case study or proof of concept showcasing the platform's effectiveness in a real-world scenario.

**Conclusion**

This research outlines the development of a comprehensive web-based platform integrating real-time GIS data with advanced simulations. The project aims to improve decision-making processes in the AEC industry. The platform will allow architects, urban planners, and other stakeholders, enhancing the accuracy and accessibility of geospatial data to provide more efficient and informed architectural planning and development.

**Research Papers**

1. Trends and Opportunities of BIM-GIS Integration in the Architecture, Engineering and Construction Industry: A Review from a Spatio-Temporal Statistical Perspective:
   * This paper reviews the integration of Building Information Modeling (BIM) and Geographic Information Systems (GIS) in the AEC industry, highlighting evolution, challenges, and future opportunities.
   * https://www.mdpi.com/2220-9964/6/12/397
2. Towards Effective BIM/GIS Data Integration for Smart City by Integrating Computer Graphics Technique:
   * This study addresses challenges in integrating BIM models into GIS environments, essential for smart city and digital twin applications.
   * https://www.mdpi.com/2072-4292/13/10/1889
3. Integration of BIM and GIS in sustainable built environment: A review and bibliometric analysis:
   * This review explores BIM-GIS integration in sustainable development, discussing benefits, challenges, and potential solutions.
   * https://www.researchgate.net/publication/334140690\_Integration\_of\_BIM\_and\_GIS\_in\_sustainable\_built\_environment\_A\_review\_and\_bibliometric\_analysis
4. An Integrated GIS Platform Architecture for Spatiotemporal Big Data:
   * Discusses the design and implementation of a GIS platform for spatiotemporal big data, offering insights into architecture and methodologies.
   * https://www.sciencedirect.com/science/article/pii/S0169204618303613
5. LEARNING MESH-BASED SIMULATION WITH GRAPH NETWORKS
   * https://arxiv.org/pdf/2010.03409