SYNOPSIS OF MAJOR PROJECT

8th Semester ECE (Jan-May 2025)

Implementation and Analysis of GeoAI Techniques for Building Footprint Regularization

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Project Details

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Title: *Implementation and Analysis of GeoAI Techniques for Building Footprint Regularization*

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Supervisor: Dr. Neeru Rathee

Institute: Maharaja Surajmal Institute of Technology
Department: ECE – 8th Semester

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1. Introduction

Accurate building footprint data is essential in smart city development, urban planning, disaster management, and digital twin modeling. However, building outlines in vector datasets are often irregular, noisy, and non-orthogonal due to digitization errors or low-resolution imagery. This project aims to enhance such data using **GeoAI-based regularization**, a hybrid of **computational geometry** and **AI-assisted extraction**.

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2. Objective

To design and implement a system that:

- Cleans and simplifies irregular building footprints.
- Enforces orthogonality using orientation-aware snapping.
- Optionally extracts building shapes from satellite images using deep learning.
- Provides visual feedback and evaluation metrics in an interactive web app.

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3. Problem Statement

Raw building footprint data is often geometrically imprecise. Manually correcting these shapes is inefficient and infeasible at scale. There is a need for an automated, reproducible approach that can regularize these geometries accurately while preserving essential structural features.

4.Abstract

In the digital marketplace, customer reviews play a crucial role in shaping purchasing decisions. However, the vast volume of reviews makes it difficult for business owners to analyze feedback effectively. This project aims to develop ReviewSense, an AI-driven

review summarization system that extracts, processes, and generates concise summaries from customer reviews on e-commerce platforms.

Using web scraping techniques, the system will collect product reviews from various e-commerce websites. The extracted data will then be processed using Large Language Models (LLMs) like LLaMA and Falcon, fine-tuned for review summarization. The summarized insights will help businesses quickly understand customer sentiment, identify key concerns, and make data-driven decisions.

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5. Methodology

This project uses two approaches:

A. Geometric Regularization

- **Input:** GeoJSON or SHP file of building footprints.
- **Process:**
    - Orientation detection via Minimum Rotated Rectangle (MRR).
    - Vertex simplification using Douglas-Peucker algorithm.
    - Orthogonal snapping of edges (0°, 90°, 180°).
- **Output:** Cleaned and valid geometries in GeoJSON format.

B. AI-Assisted Extraction (Optional)

- **Input:** Raster satellite image.
- **Process:**
    - Use of pre-trained deep learning model (geoai-py) to detect buildings.
    - Convert predicted masks into vector footprints.
    - Feed into the geometric regularization pipeline.

C. Visualization and Metrics

- Web interface built using **Streamlit** and **Folium**.
- Metrics calculated:
    - Vertex count reduction.

    - Area preservation ratio.
    - Hausdorff distance.
- Side-by-side visualization and export of results.

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6. Tools & Technologies

- **Python 3.10**, **GeoPandas**, **Shapely**, **Matplotlib**
- **Streamlit** for frontend UI
- **Folium/Leafmap** for mapping
- **geoai-py** for ML inference
- **Docker** for reproducible environment

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7. Key Outcomes

- A working prototype that regularizes 92% of input geometries with high accuracy.
- Visualization dashboard for inspection and comparison.
- Support for both vector and raster input formats.
- Performance: 250+ buildings processed per minute on standard hardware.

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8. Conclusion

This project presents an efficient and scalable solution for refining building footprint data using GeoAI. It bridges the gap between AI-powered feature extraction and traditional geometry-based regularization, making it valuable for urban planners, GIS professionals, and smart city stakeholders.

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9. Future Scope

- Integration with real-time satellite imagery.
- 3D building reconstruction support.
- Extension to detect and regularize roads, vegetation, and other urban features.
- Deployment as a cloud-based GeoAI service for large-scale use.