

Strategic Urban Greening: Combating Urban Heat Islands with Satellite Image Segmentation and Thermal Analysis

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Problem Statement

The Urban Heat Island (UHI) phenomenon, characterized by elevated temperatures in urban areas resulting from alterations in land surfaces due to urban development, presents critical environmental and health challenges. These challenges encompass heightened energy consumption, increased pollution, and significant adverse health effects. Mitigating the UHI effect is essential for enhancing urban sustainability.

This project intends to:

- Utilize U-Net for semantic segmentation of satellite imagery to classify urban land into distinct categories such as infrastructure, green spaces, vacant areas, and water bodies within the specified region.
- Integrate the classified land data with UHI metrics derived from thermal infrared satellite imagery to investigate the relationship between urban land use patterns and UHI intensity.
- Identify areas experiencing significant UHI effects and lacking in green coverage, to target the establishment of urban mini forests. This initiative aims to significantly reduce UHI effects, contributing to the development of cooler and more environmentally balanced urban areas.

Preliminary Literature Survey

The literature survey examined the Urban Heat Island (UHI) effect, exploring its causes, impacts, and mitigation approaches, with a focus on urban greenery's role in reducing urban temperatures. Key insights include:

- UHI Dynamics: Research shows urban development's role in UHI through the heat absorption and emission differences between built and natural environments (Oke, 1982).
- Mitigation Strategies: Studies affirm urban green spaces' effectiveness in UHI mitigation via shading and evapotranspiration (Gill et al., 2007; Akbari, 2009).
- Technological Approaches: The utility of remote sensing and GIS for urban classification and UHI analysis, with thermal infrared satellite imagery being particularly useful for mapping UHI intensity (Weng, 2009; Tran et al., 2017).
- Semantic Segmentation: Advances in machine learning, notably U-Net, have shown promise in accurately segmenting urban land cover from satellite imagery (Ronneberger et al., 2015).

This review highlights the significance of green infrastructure and imaging technologies in addressing UHI, laying a robust groundwork for the project.

Preliminary Work

Our initial work has focused on building the foundation necessary for the project:

1. Neural Network Training: Focused on understanding neural networks, with an emphasis on image processing and semantic segmentation applications.
2. U-Net Implementation: Implemented the U-Net model for satellite imagery segmentation, addressing essential preprocessing for improved model performance. [Link to U-Net implementation](#).
3. Satellite Imagery Acquisition: Utilized the Python API for acquiring high-resolution satellite imagery datasets from platforms such as Google Earth Engine, focusing on data relevant to our study area. [Link to relevant datasets](#).

References

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