

Using Satellite Imagery and Geo AI for Long-Term Urban Growth: A Case Study of Riyadh

الاستفادة من صور الأقمار الصناعية والذكاء الاصطناعي الجغرافي لتحقيق التنمية الحضرية المستدامة: دراسة حالة مدينة الرياض

Abstract

Rapid urbanization is putting real pressure on cities — from shrinking green spaces to unexpected urban sprawl and overstressed infrastructure. This research introduces a practical, integrated framework that brings together high-resolution satellite imagery and geospatial artificial intelligence (Geo-AI) to support smarter, more sustainable urban planning. First, we'll process and analyze remote-sensing data to pull out important features like building shapes, vegetation coverage, and how land use is shifting. Then, we'll apply deep learning methods — including object detection and segmentation networks — to classify and measure these features precisely. On top of that, we'll explore using generative AI (such as diffusion models) to simulate potential future urban scenarios under different planning strategies. Our case study focuses on **Riyadh**, where this methodology will be used to map green spaces, forecast city growth, and gauge the impact of planning decisions. The goal is to deliver a geospatial intelligence tool that city planners can use, backed by quantifiable metrics (like green-coverage ratios) and visually compelling, scenario-based design simulations. In doing so, this research aims to offer a scalable, repeatable model to guide sustainable development, helping policymakers optimize how they allocate resources and shape the city's future.

Objectives

1. To build a Geo-AI pipeline that can process satellite images and pick out key urban features like building footprints, green spaces, and roads.
2. To use deep learning (for example, CNNs and semantic segmentation) to classify land use changes and monitor how vegetation evolves over time.
3. To create possible future urban development scenarios using generative AI (such as diffusion models), guided by different land-use and planning policies.
4. To assess how current and proposed planning interventions can affect sustainability, by measuring things like the density of green space, growth of built-up areas, and shifts in land-use.
5. To design a decision-support tool (a dashboard or GIS-based app) for planners and policymakers, so they can visualize satellite-derived data and AI-driven future scenarios.
6. To validate this whole approach through a real-world case study in Riyadh — including, where possible, ground-truth checks and feedback from experts and city planners.