A Data-Driven Framework for Urban Mobility

Real-Time Traffic Analysis in Dubai Using Google Maps API and R

Bibin Prathap
Microsoft MVP (AI platform)

The Paradox of Growth

Dubai's success story brings unprecedented mobility challenges. Since 2021, over 378,000 new residents arrived, driving 10% vehicle growth—far exceeding the global 2-4% average.

35	378K	10%	154th
Hours Lost	**New Residents**	**Vehicle Growth**	**Global Rank**
Average time lost to congestion in 2024—a 45% increase since 2022	Population growth since January 2021	Two-year registration increase rate	Congestion ranking—better than London, New York, Istanbul

Dubai ranks 154th globally for congestion, outperforming major hubs where drivers lose 100+ hours annually. This isn't system failure—it's a high-performing network under unprecedented stress.

Research Objective

The Challenge

RTA invests billions in smart mobility: UTC-UX Fusion signals, V2X networks, AI-driven digital twins aligned with UAE Centennial 2071.

These top-down solutions need complementary, bottom-up intelligence.

Our Thesis

Transform publicly available Google Maps traffic data into quantitative, machine-readable format using R programming.

Deliver low-cost, scalable framework providing real-time, high-resolution traffic understanding across the entire city—not just sensor-equipped intersections.

Framework Architecture

Acquisition

Tap Google Maps Traffic Layer powered by millions of anonymized GPS signals

Transformation

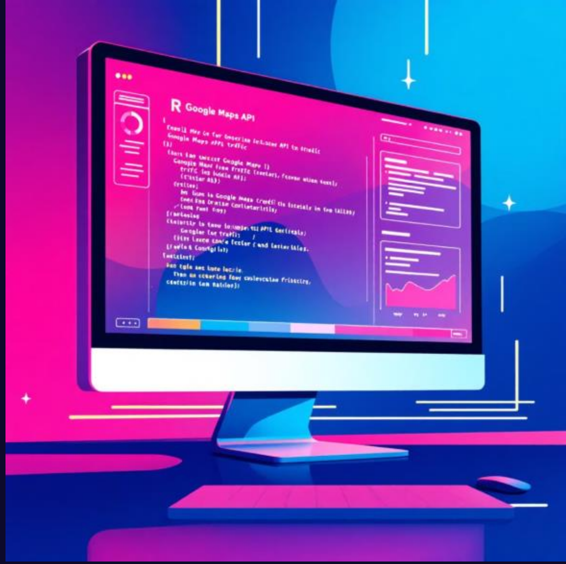
Process with R's googletraffic package and geospatial libraries

Analysis

Generate georeferenced rasters and statistical insights

Unlike expensive fixed-point sensors with limited coverage, crowdsourced data captures dynamics on virtually every road—from highways to local streets. R's mature ecosystem (sf, terra packages) provides unparalleled statistical and geospatial analysis capabilities.

Step 1: Programmatic Data Capture



The googletraffic Package

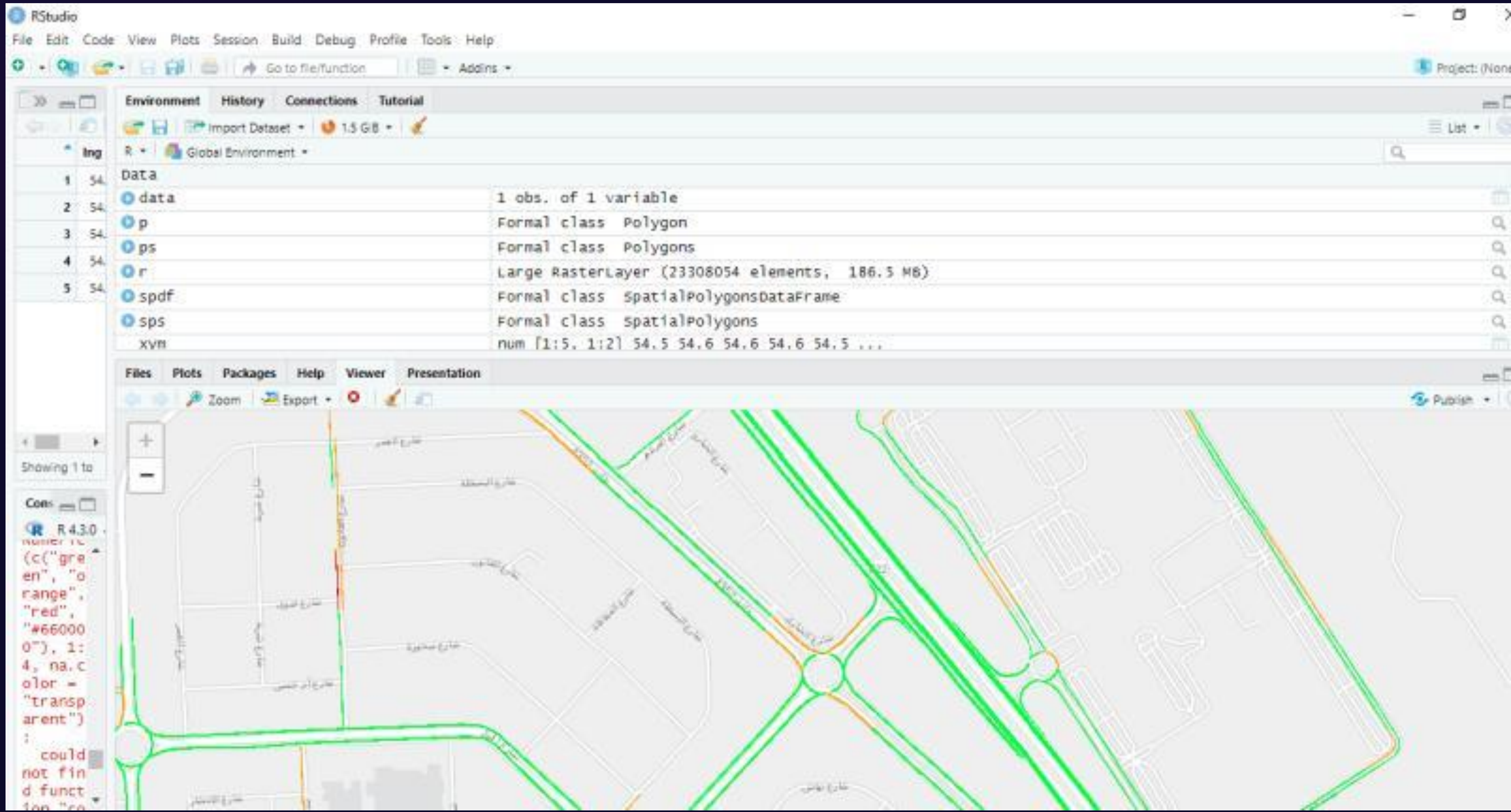
Open-source R tool interfaces directly with Google Maps JavaScript API, querying traffic layer for specified bounding boxes.

Returns visual representation as PNG image—familiar green, orange, red lines become raw input for transformation.

Zoom Optimization

Higher zoom (level 20): sub-meter resolution, captures local roads

Lower zoom (level 10): wider coverage, shows major highways



Step 2: Transforming Pixels into Places

The critical innovation: converting non-spatial PNG images into **georeferenced rasters**.

01

Georeferencing

Assign real-world geographic coordinates to each pixel using bounding box coordinates, image dimensions, and Coordinate Reference System (CRS)

02

Mathematical Transformation

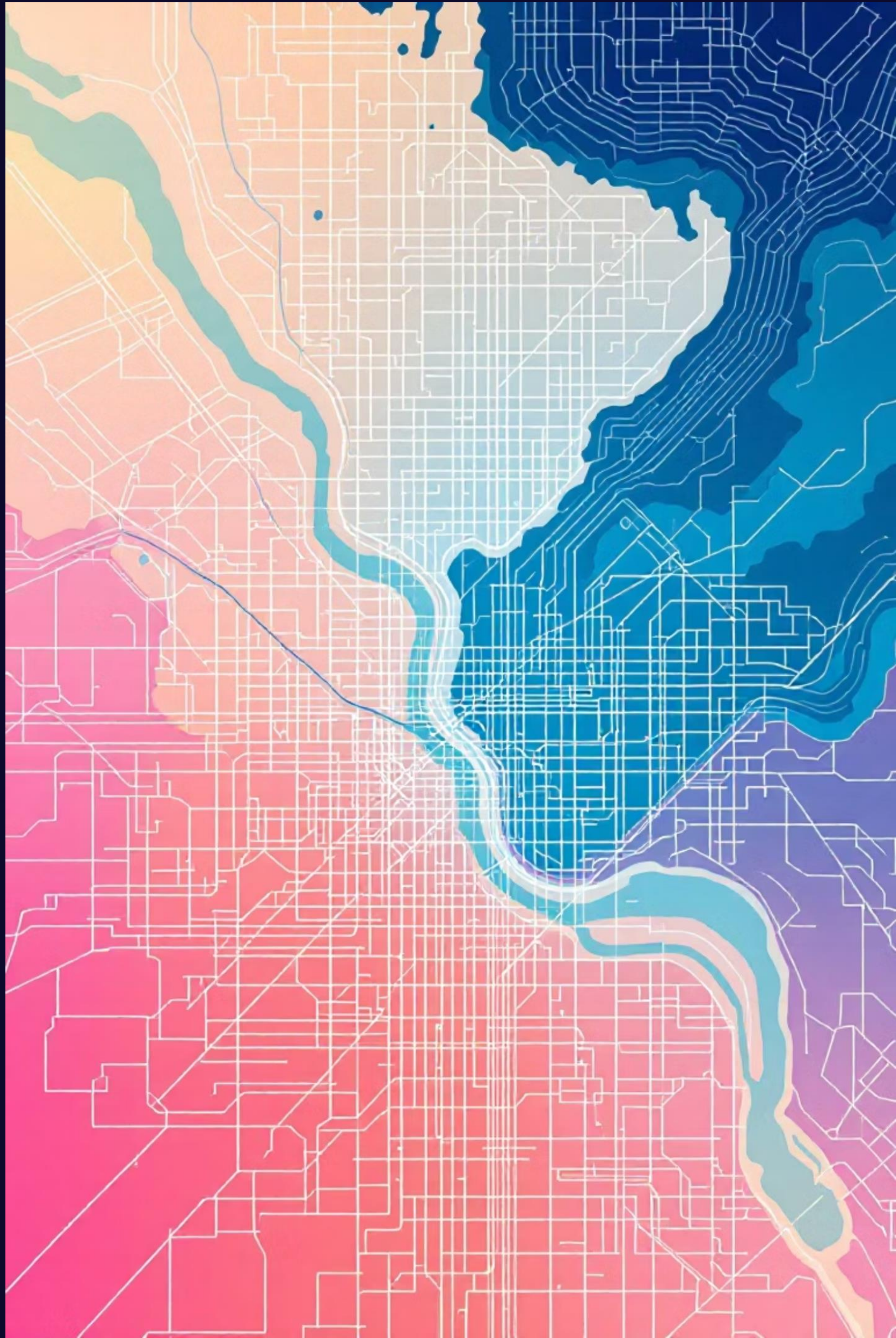
Create link between image's pixel grid (rows/columns) and specific Earth surface locations

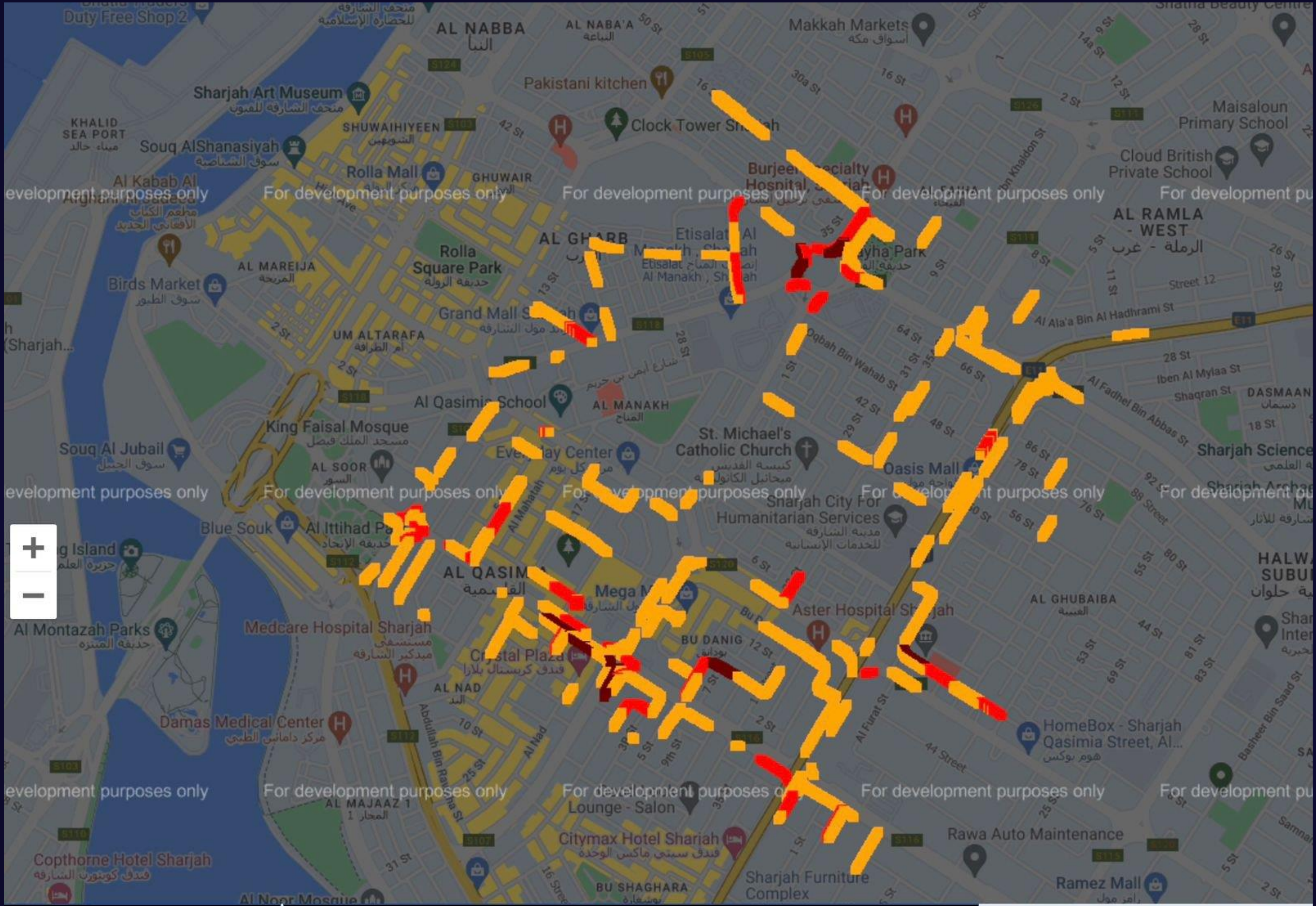
03

Raster Creation

Generate GIS-ready grid where each cell ties to geographic location and contains analytical value

Result: spatially aware, structured dataset ready for sophisticated geospatial operations—transforming pictures into analytical intelligence.





Area Name

15 May - 15 May 2023

Date Range

15/05/2023 - 15/05/2023

Time Range

12:41 AM - 12:15 PM

15 Monday May 2023

Step 3: Quantifying Congestion

Green = 1

No delays, free-flowing traffic

Orange = 2

Medium traffic, some slowdowns

Red = 3

High traffic, significant delays

Dark Red = 4

Heavy traffic, gridlock conditions

The googletraffic package systematically analyzes pixel colors, mapping them to ordinal numeric scale. Final output: georeferenced raster where each pixel contains traffic level value (1-4) at precise geographic location—fully machine-readable and ready for rigorous analysis using R's sf and terra packages.

Case Study: Sheikh Zayed Road Corridor

Validation study on 20-kilometer stretch capturing traffic at three critical time points on a typical weekday:



Morning Peak (8:30 AM): Heavy congestion on southbound lanes toward downtown business districts

Off-Peak (2:00 PM): Network dominated by green, free-flowing traffic

Evening Peak (6:30 PM): Intense congestion both directions as commuters return home

These raster maps provide immediate, intuitive visualization of the city's daily circulatory rhythm

Quantifying Network Stress

Beyond visualization: precise measurement of network proportion under different stress levels.

Time of Day	Traffic Level	Value	% of Network Affected
8:30 AM Peak	No Delays	1	21.4%
	Medium	2	30.9%
	High	3	**35.2%**
	Heavy	4	**12.5%**
2:00 PM Off-Peak	No Delays	1	78.1%
	Medium	2	14.9%
	High/Heavy	3-4	7.0%
6:30 PM Peak	No Delays	1	15.8%
	Medium	2	28.5%
	High	3	**41.1%**
	Heavy	4	**14.6%**

Morning peak: 48% of network experiences high/heavy traffic. Off-peak: only 7%. Evening peak: over 55%—confirming perceived severity with empirical data. This quantification enables objective assessment, temporal tracking, and rigorous measurement of policy intervention effectiveness.

Key Advantages & Future Directions

Cost-Effective & Scalable

No new infrastructure required. Leverages existing data streams. Scales from single corridor to entire emirate with minimal additional cost.

Comprehensive Coverage

Wide-angle lens on entire road network. Discovers hidden bottlenecks on secondary roads missed by traditional monitoring.

Independent Validation

Ground-up data from road users themselves. Verifies, calibrates, and enhances official top-down systems.

Hybrid Model

Fuse crowdsourced data with RTA sensor data for best-of-both-worlds accuracy

Network Analysis

Integrate OpenStreetMap data to identify congestion-prone road classifications

Predictive Analytics

Apply machine learning for short-term traffic forecasting and proactive mitigation

Conclusion: This framework complements RTA's billion-dirham investments, providing rapid ground-truthing for AI-driven policies, validating Digital Twin simulations, and enabling evidence-based decisions. A meaningful step toward managing growth pressures and securing Dubai's leadership in smart urban mobility.

Thank You

Questions?

I'd love to hear from you and discuss how we can work together.

Get in Touch

Bibin Prathap

bibinprathap@email.com

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