DEEP LEARNING FOR WATER POINT DETECTION & MAPPING USING STREET-LEVEL IMAGERY

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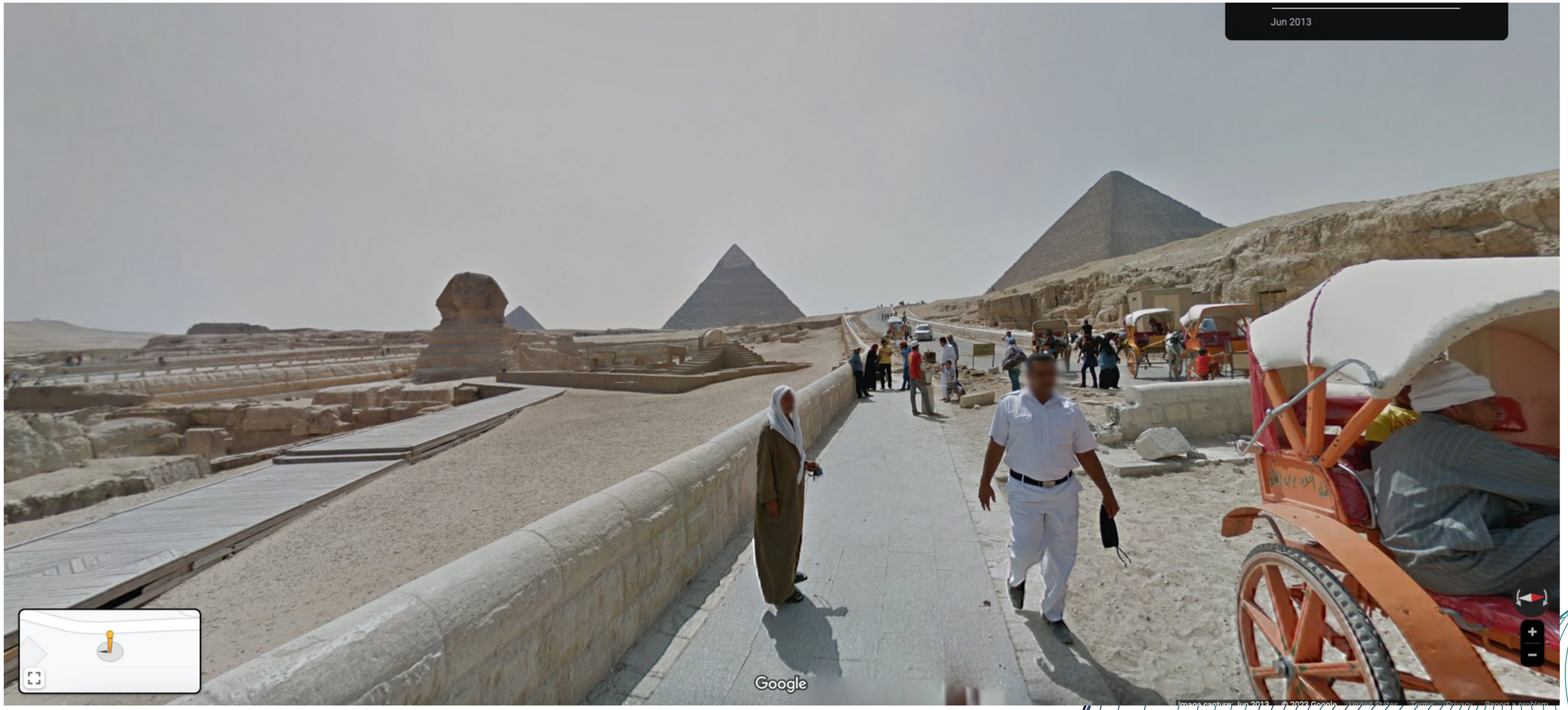
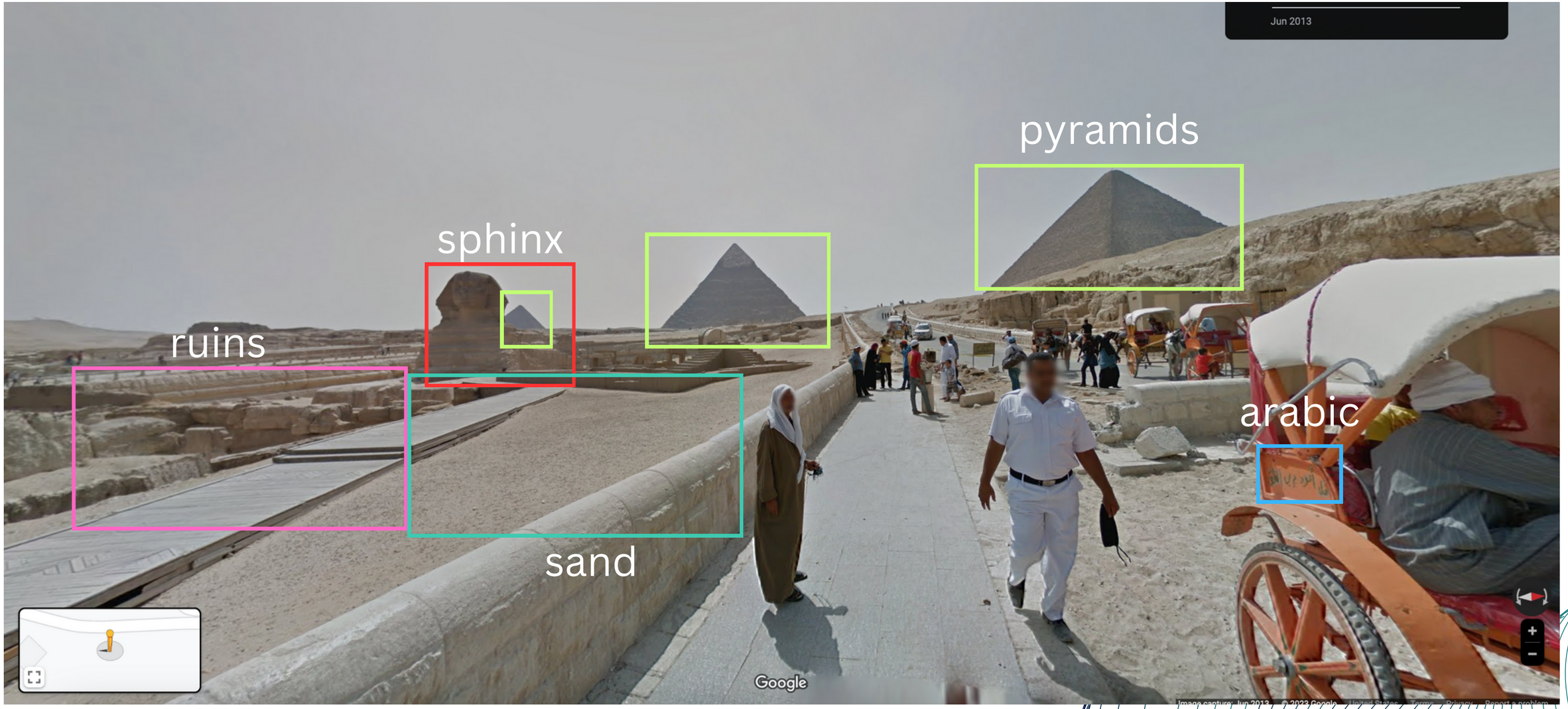
“MISSING” WATER POINTS

- Nearly half of households in Lagos rely on public water facilities constructed by private actors
- **GRID3 Public Water Points Dataset** contains just **16%** of estimated communal facilities
- More than **6,000 “missing“ water points**! So,,, how do we find them?



IMAGES ARE DATA

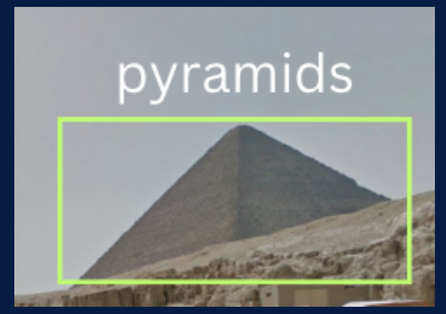


IMAGES ARE DATA

DEEP LEARNING

Modeling the human thought process to conduct visual inference at a rapid scale

Extract Visual Features from Image

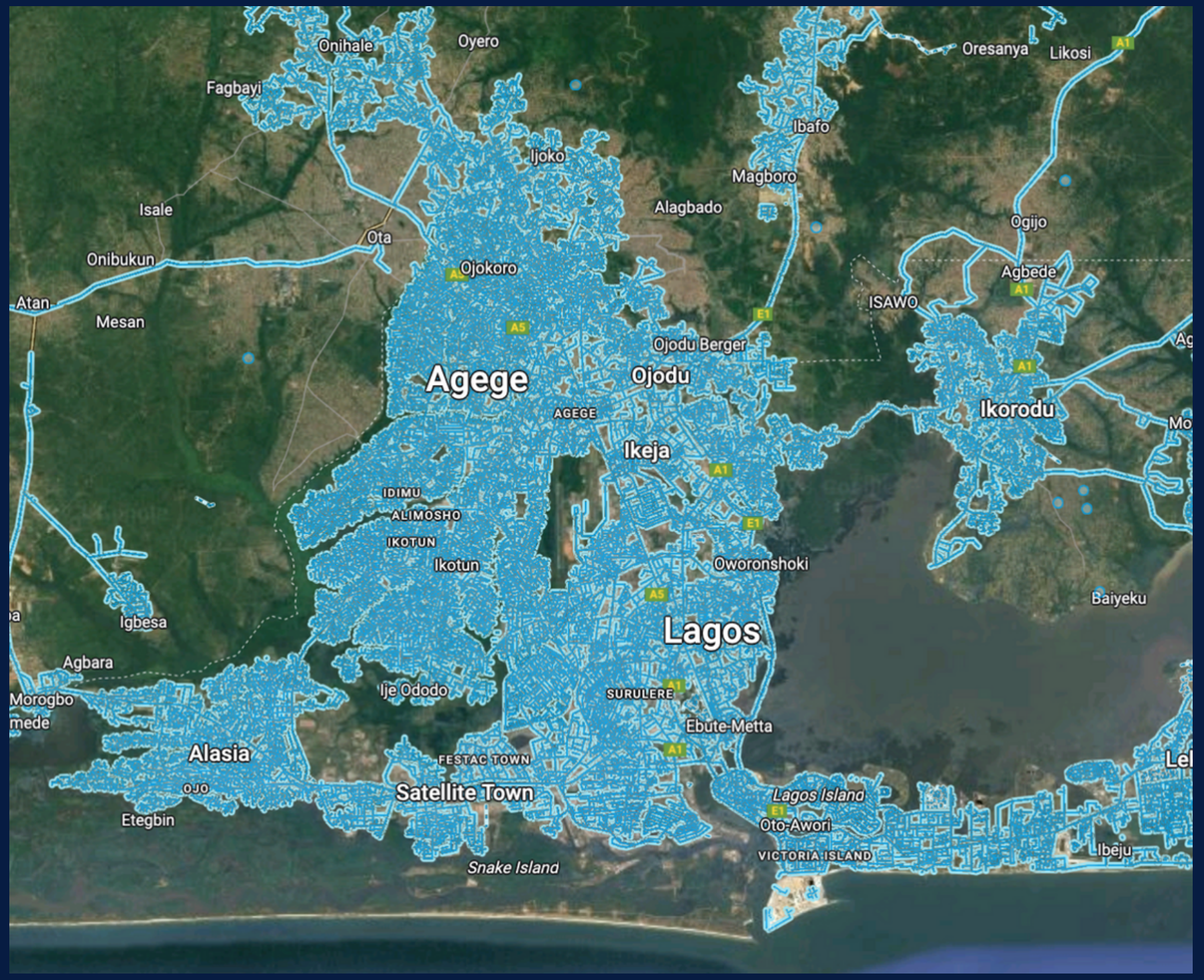


Compare to Prior Knowledge

Predict Image Classification

GOOGLE STREET VIEW

- More than 12,000 km of publicly-available 360 degree street-level imagery in Nigeria alone
- Potentially the **world's largest dataset** of geo-referenced information on the built environment
- Deep learning tools (CNNs) allow us to extract visual information and convert into a tabular form we can analyze



MODEL OVERVIEW

YOLOv5s object detection model trained on 215 Google Street View images of confirmed public water points sampled from GRID3 Nigeria datasets

Performance Metrics:

- **Precision:** 92.8%
- **Recall:** 88.0%
- **F1 Score:** 90.3%

PILOT RESULTS

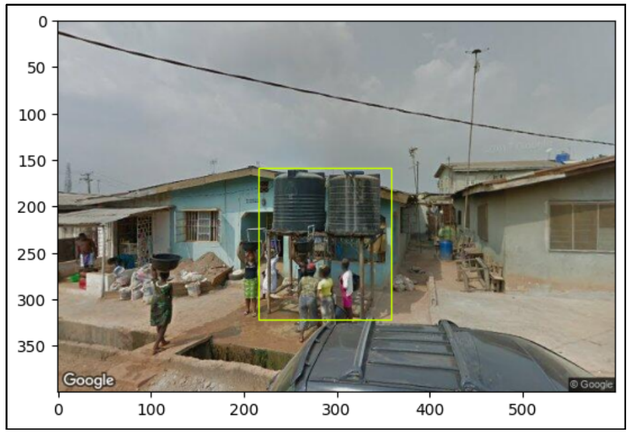
39
kilometers

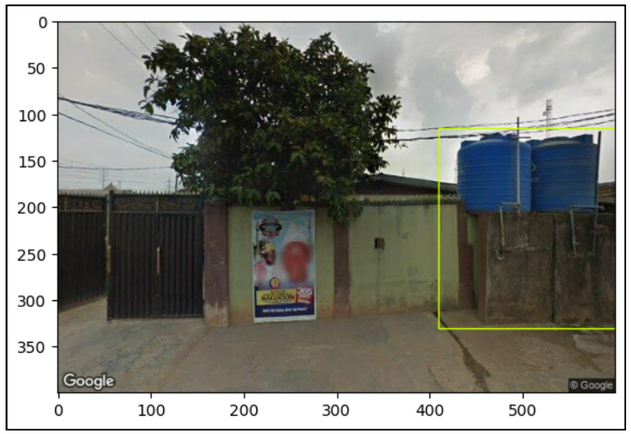
36
water points

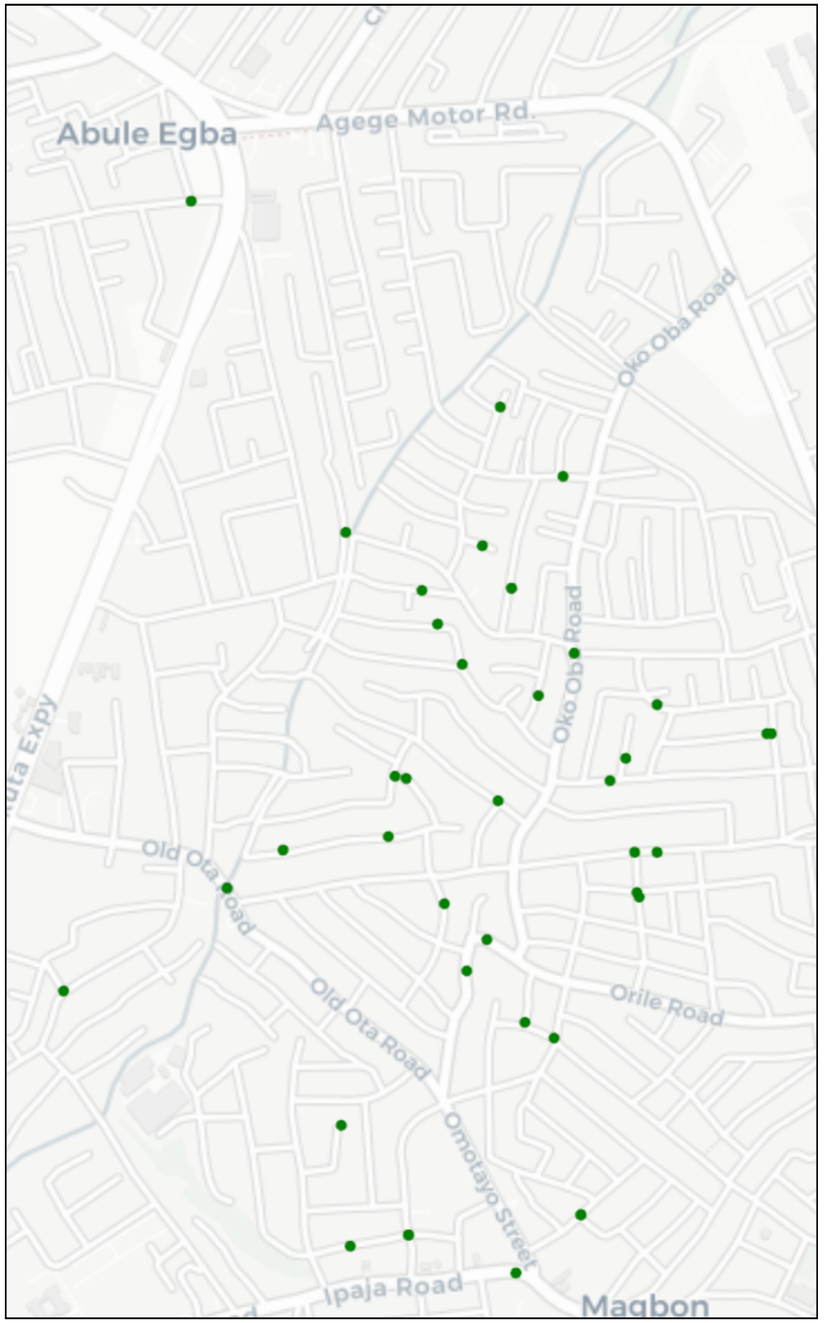
95%
precision

28
minutes

$0
OOP Expenses







MORE INFO

GitHub: Contains full Colab tutorials for downloading GSV images and deploying the model on your own dataset

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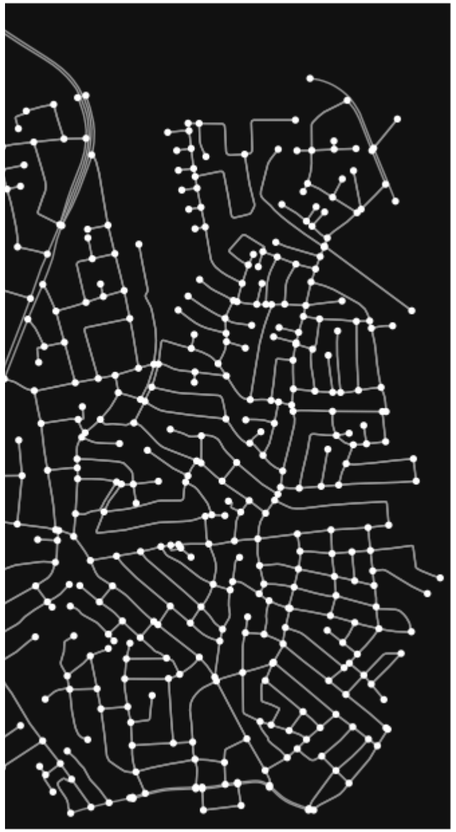
ANNEXES



Download Street Network

Generate Request Points

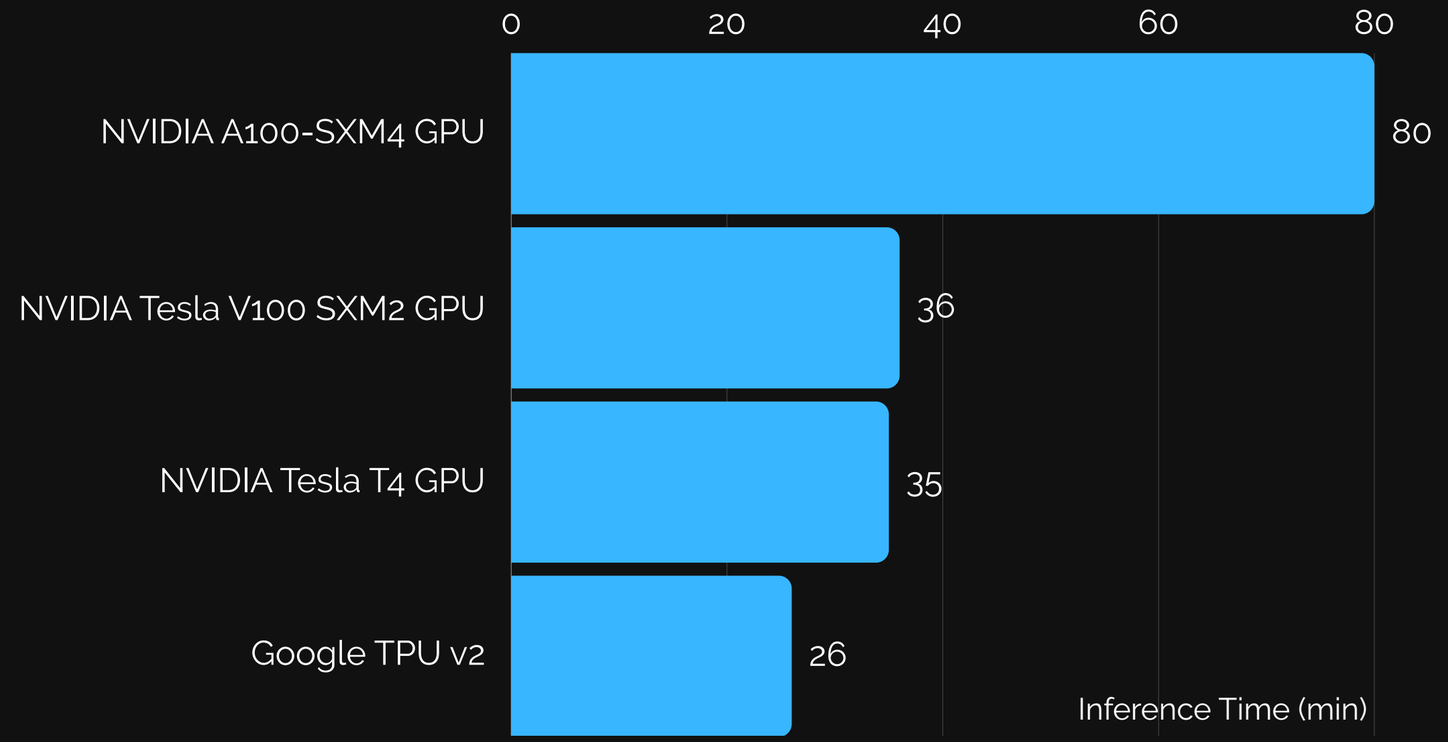
Download Images

IMAGE EXTRACTION PROCESS

SCALABILITY

- Model is highly scalable through **free cloud-hosted GPUs** available through Google Colab

- Google Street View Static API allows ~28K images to be downloaded **free-of-charge** per month (~357 km)



BENCHMARKS: AFRICAN MAJOR CITIES

	Kilometers	Frames	Processing Time	Cost (USD)	Months Required (Credits)
Kisumu, Kenya	336	268,800	39-118 hours	$1,305	9
Accra, Ghana	1899	1,519,200	220-670 hours	$8,308	53
Kampala, Uganda	610	488,000	70-215 hours	$2,533	17
Dar es Salaam, Tanzania	1140	912,000	132-402 hours	$4,907	32
Kigali, Rwanda	984	787,200	114-347 hours	$4,208	27

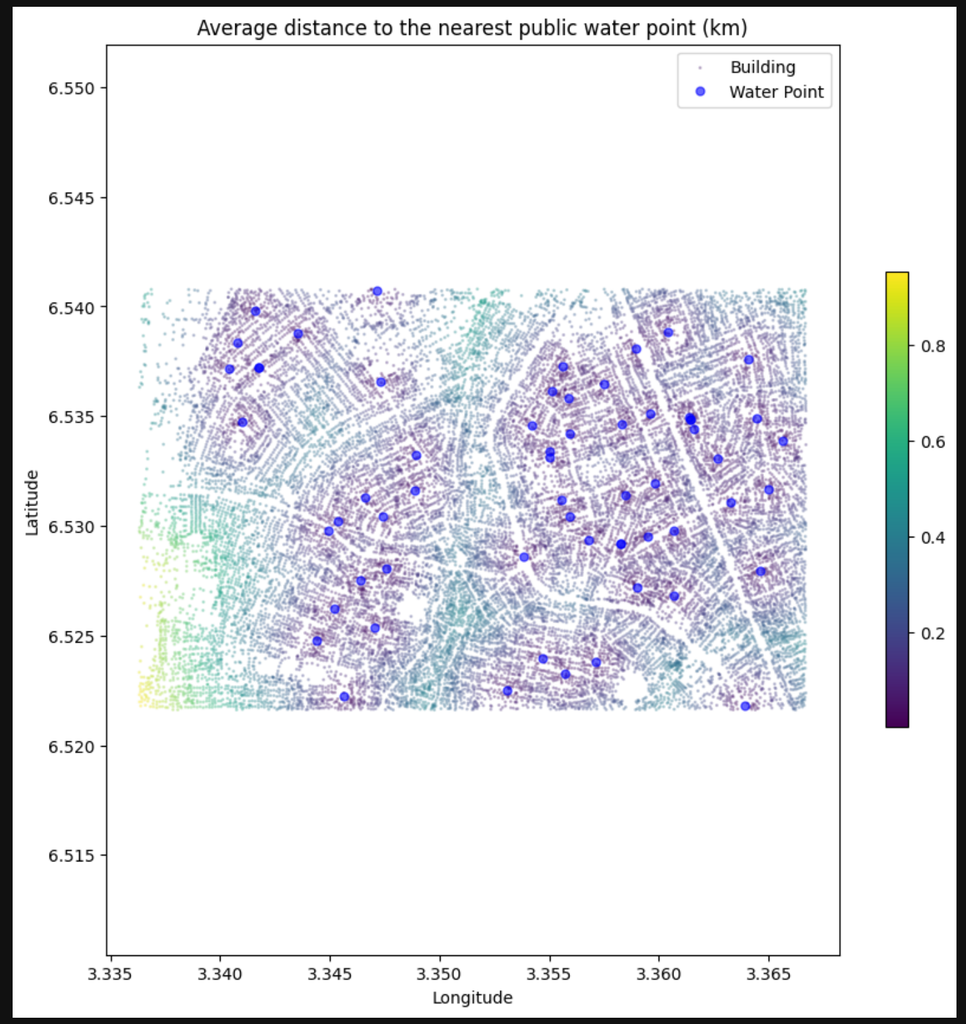
WHY GEOSPATIAL DATA MATTERS

Producing accurate localized metrics on access to safe and reliable water sources

Targeting subsidies for water access

Coordinating infrastructure expansion between public, private, and community actors

Measuring quantity of private boreholes and monitor groundwater abstraction



TRAINING RESULTS

- *Training:* 150 epochs w/ batch size of 16
- *Optimizer:* Stochastic Gradient Descent
- *Loss:* YOLOv5s (combination of Objectness, Classification, and Box loss)

92.8%
Precision

88.0%
Recall

90.3%
F1