Global Streetscapes

A comprehensive dataset of 9 million street-level images across 688 cities for urban science and analytics

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Urban analytics, volunteered geographic information, data fusion, GeoAI, machine learning, spatial data infrastructure

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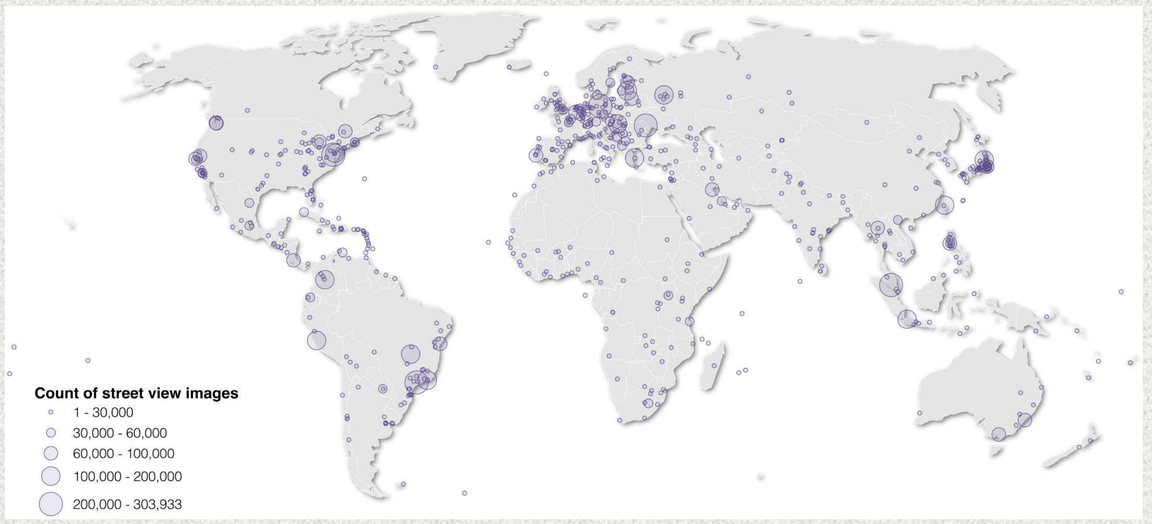
BACKGROUND

- Street View Imagery (SVI) has enabled a wide variety of urban sensing and analytics use cases
- SVI is heterogeneous, but often used without adequately evaluating its quality and fitness of use, potentially causing biases in results
- Lack of labels to describe the diverse characteristics of SVI
- Untapped potential in crowdsourced SVI (e.g. Mapillary, KartaView)
- Difficulty to download and process massive data excludes less computationally inclined researchers, and limits the scale of study

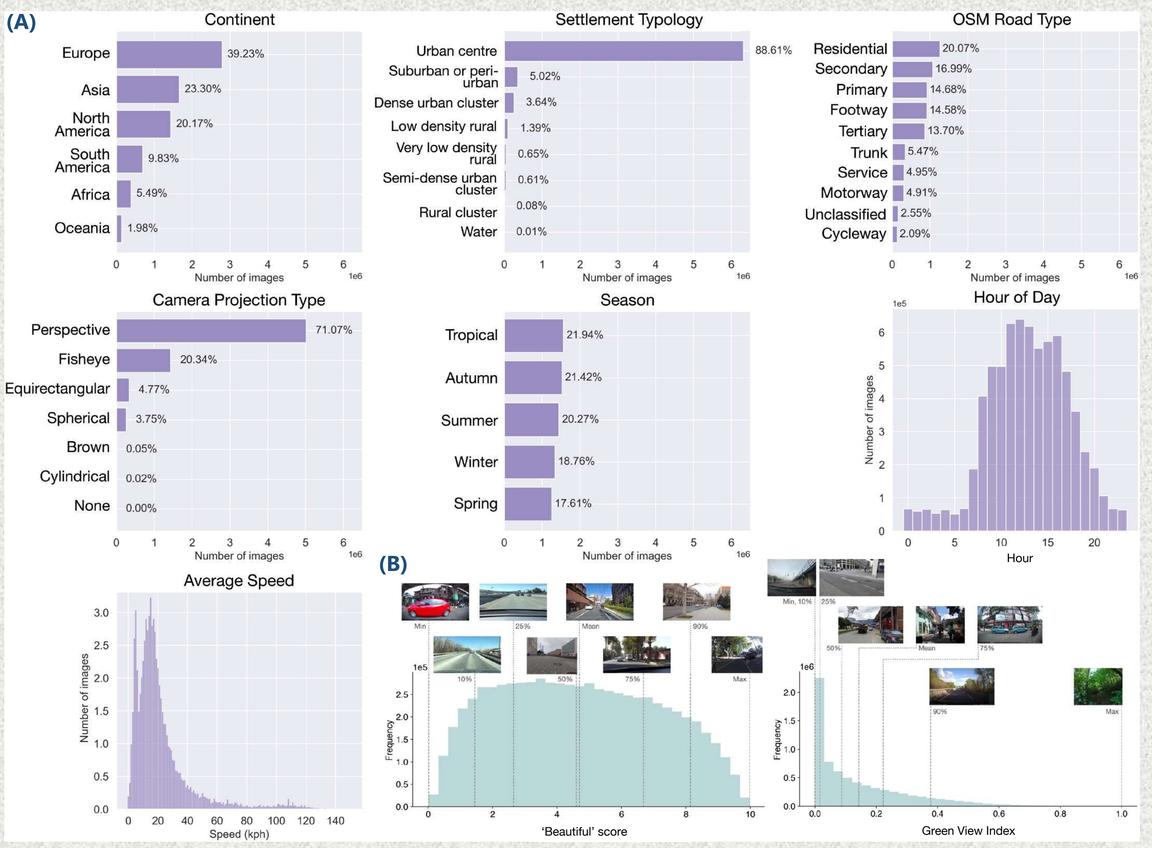
RESEARCH GAP

- Lack of an openly accessible SVI dataset with balanced coverage and comprehensive labels
- Lack of a benchmark to advance development of related computer vision (CV) techniques

RESULTS



Geographic coverage of Global Streetscapes across 688 cities, with the amount of SVIs for each city.



(A) Class and value distribution for various attributes; (B) Histograms of 'beautiful' perception scores and green view index (GVI) values, with example images at various statistical values.

CONTRIBUTIONS

- A large open, labelled, processed, and worldwide SVI dataset—Global Streetscapes, the first of its kind
- A reproducible framework using SVI contributions of myriads of Mapillary and KartaView volunteers from all over the world
- Tackling the main bottleneck of usability of crowdsourced SVI—widely heterogeneous conditions and characteristics
- Comprehensive ground-truth contextual labels, and state-of-the-art CV benchmarks

Scan QR code to follow updates on GitHub

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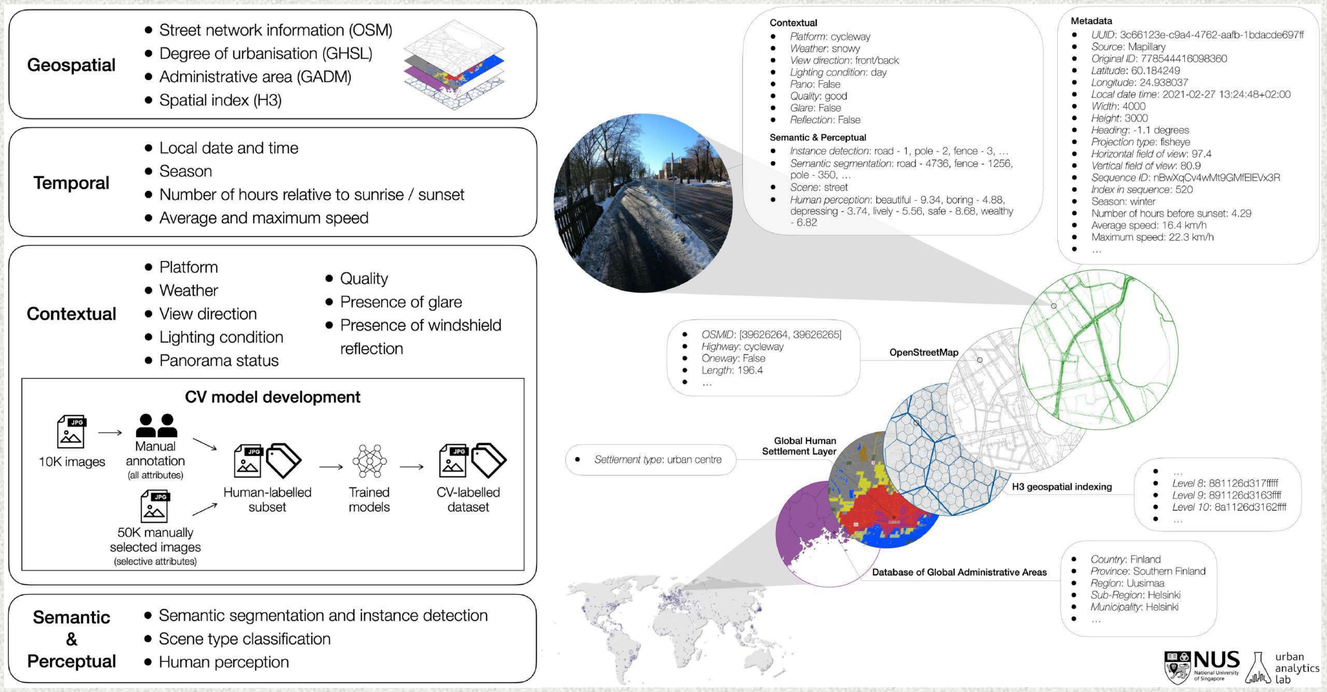
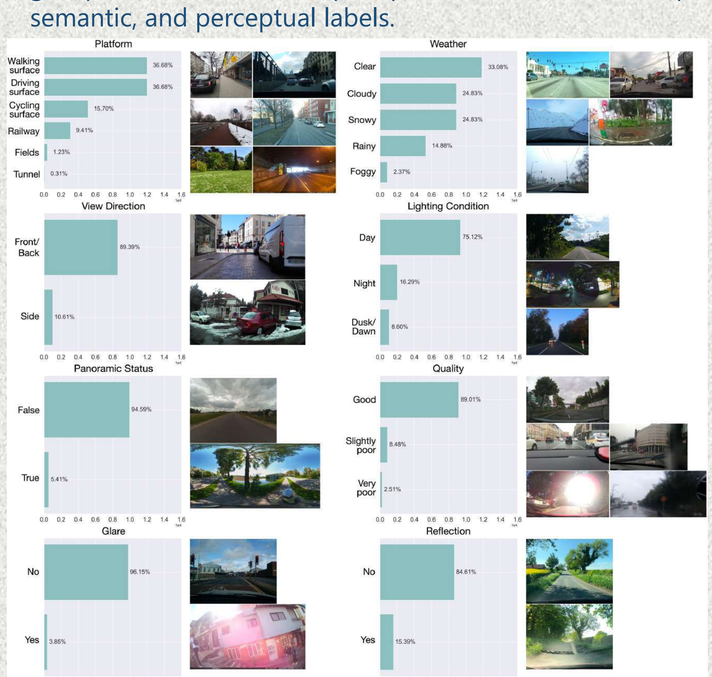
RESEARCH OBJECTIVES

- Develop an **open**, comprehensively **labelled** SVI dataset with balanced **coverage**
- Provide a **benchmark** to advance the development of relevant CV models

METHODS



More than 9 million SVIs were sampled from 688 cities from Mapillary and KartaView, integrated with geospatial data from multiple open sources, and further processed to derive additional temporal, contextual, semantic, and perceptual labels.



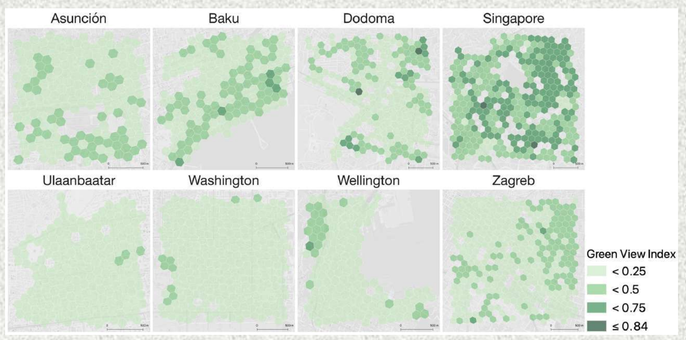
Class distribution of the eight contextual attributes among the manually labelled images.

Overview of the CV models used for labelling contextual, semantic, and perceptual attributes. For the eight contextual attributes, the models were trained with our manually labelled data; the accuracy and F1 score on the test set are reported below. For the others, state-of-the-art models were used for inference.

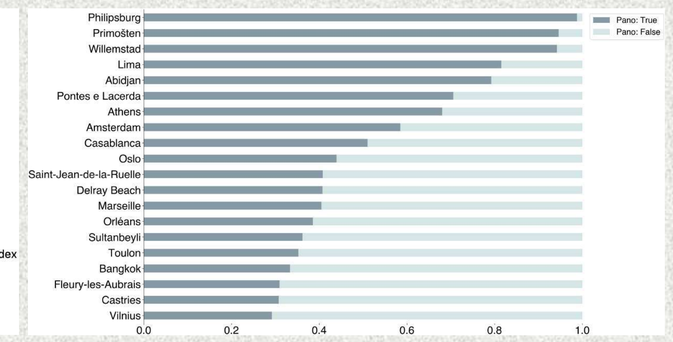
Attribute	Model	Accuracy	F1 Score
Panoramic status	MaxViT	0.999	0.995
Lighting condition		0.962	0.905
Glare		0.941	0.631
View direction		0.874	0.780
Quality		0.799	0.410
Reflection		0.787	0.757
Weather		0.755	0.599
Platform		0.683	0.567
Instance detection	Mask2Former	Inference only	
Segmentation			
Scene type	VGG16		
Perception	ViT		

KEY DISCUSSION POINTS

Our openly accessible, contextually rich dataset could enable a wide range of use cases requiring images with diverse characteristics and perspectives that are often lacking in commercial datasets. With comprehensive labels, the user can query for images suitable for their research purpose, greatly enhancing SVI usability.



Comparative study: Spatial distribution of GVI aggregated at level-10 H3 grid, across eight cities from six continents.



Data quality: Ranking percentage share of panoramas in the top 20 cities in the dataset.

- Benefit existing urban analytics topics and enable new research lines that are global-scale, comparative, and longitudinal
- Support research in other topics such as data quality, data generation, and computer vision
- Promote equity in research with wide coverage and low barrier to use

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