Building exposure datasets using street-level imagery and deep learning object detection models

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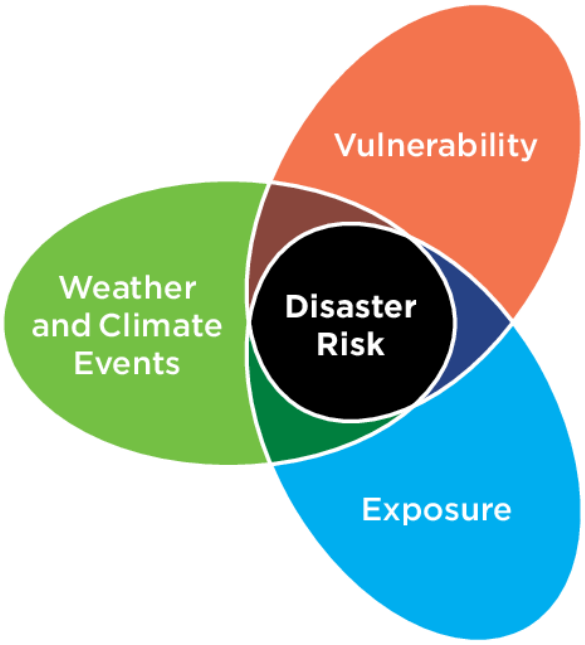
Risk Analysis



) FROM IPCC 2012.[452]

- **Hazard**: defined as the potential occurrence of a natural or human-induced physical event.
- **Vulnerability**: defined as the propensity or predisposition to be adversely affected by an hazard.
- **Exposure**: defined as the presence of people; livelihoods; species or ecosystems; environmental functions, services and resources; infrastructure; or economic, social or cultural assets in places and settings that could be adversely affected

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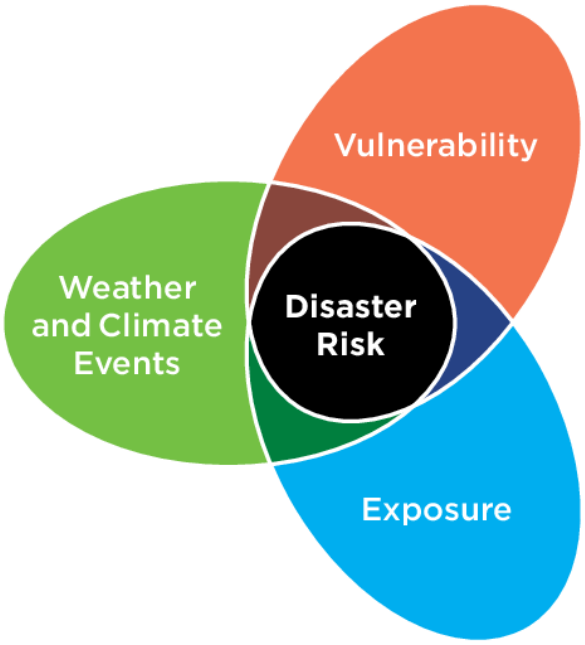

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Exposure modelling

- For large areas, the general approach requires disaggregating to fine resolution coarse resolution data.
    - Population data
    - GDP data
    - Land use area
    - Road Density
- In smaller areas, exposure information come from different sources that are not really easy to control.

VGI and UGC bridge the gap between the two resolution

Motivation

Exposure modelling using object detection and volunteered geographic information

The main reason was that I wanted to work with images and object detection

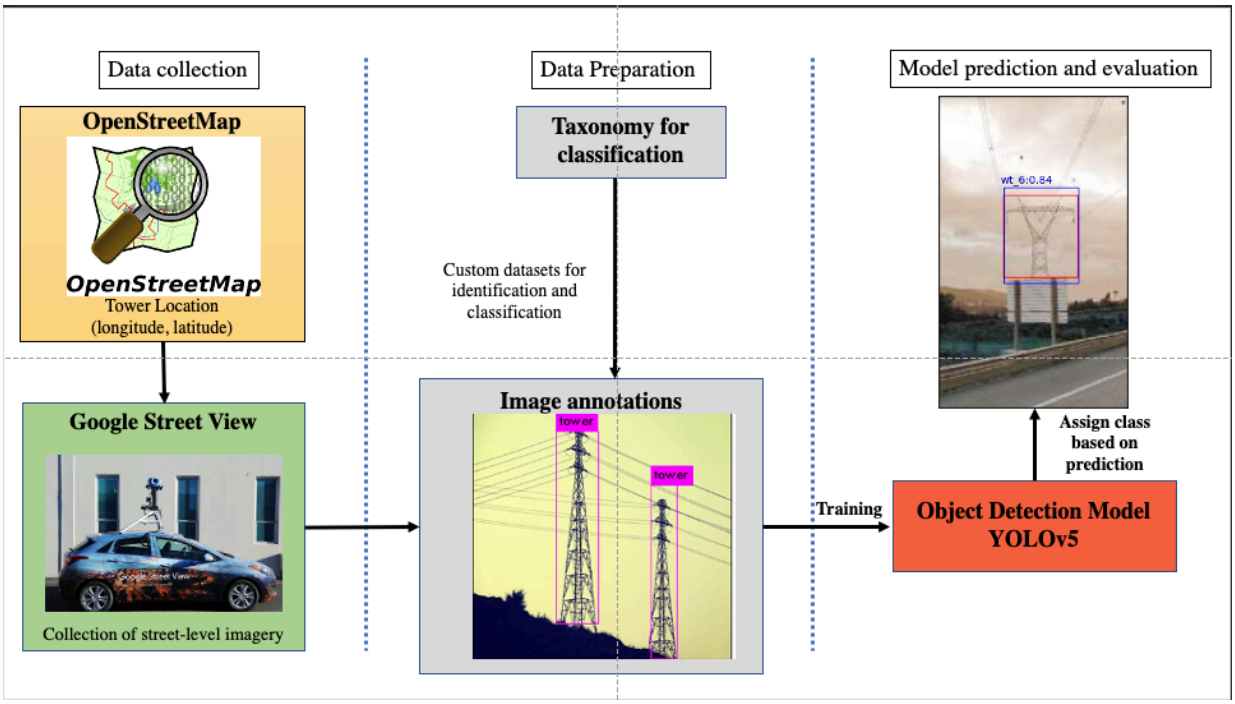
Still, transmission towers are vulnerable assets to several hazards like:

- Strong winds
- Earthquake
- Ice loads

Finally, the combination of VGI, street-level imagery and DL models is rare.

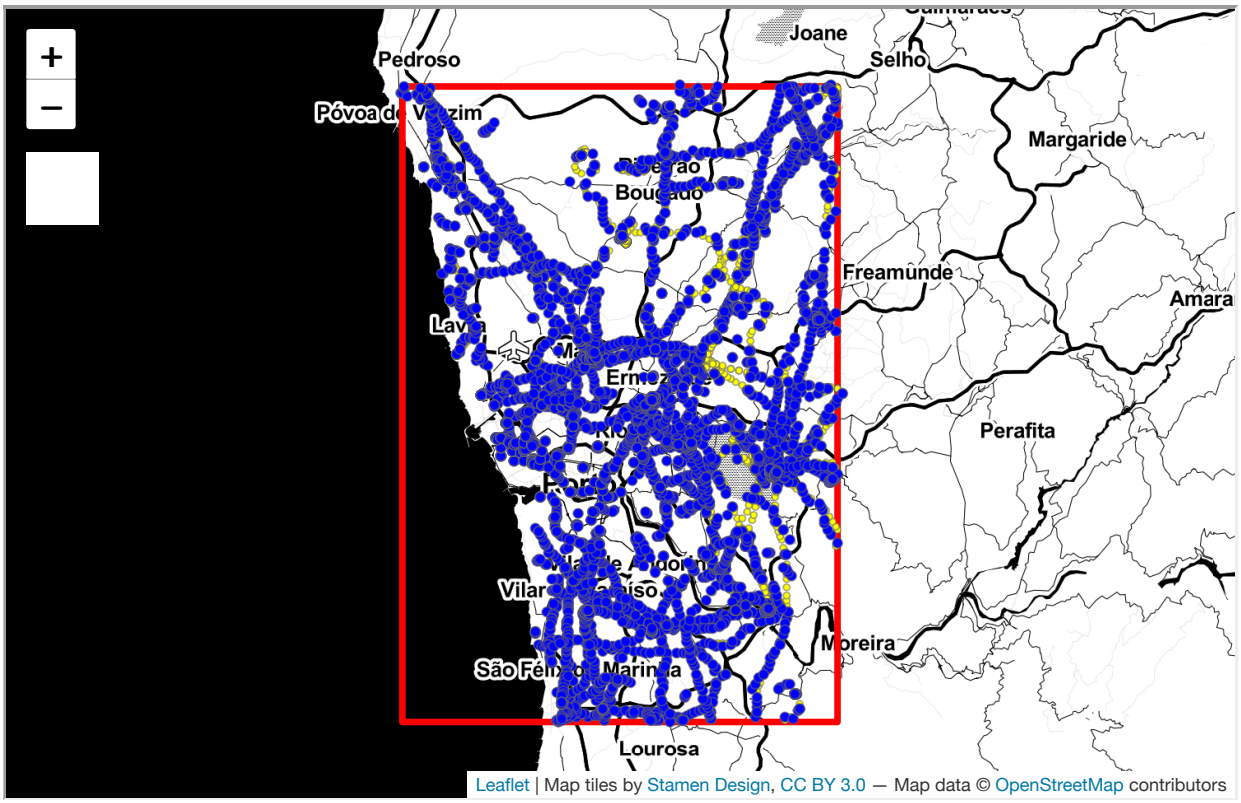
The methodology

An automated start-to-end pipeline that returns relevant features of towers



Study area

Around 6k towers and multiple POV



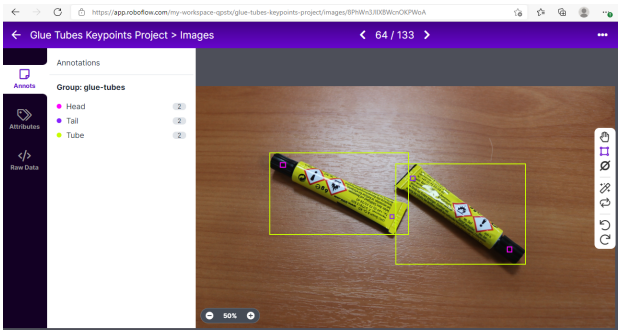
Development of the taxonomy and training of the model

Name	Family	Label	Icon
Single level	Self-supporting	ss_1	
Double level	Self-supporting	ss_2	
Triple level	Self-supporting	ss_3	
Modified delta structure	Self-supporting	ss_4	
Delta	Waist-type	wt_5	
Portal	Waist-type	wt_6	
Tubular single level	Monopole	mono_7	
Tubular double level	Monopole	mono_8	
Tubular triple level	Monopole	mono_9	
Tubular modified delta structures	Monopole	mono_10	

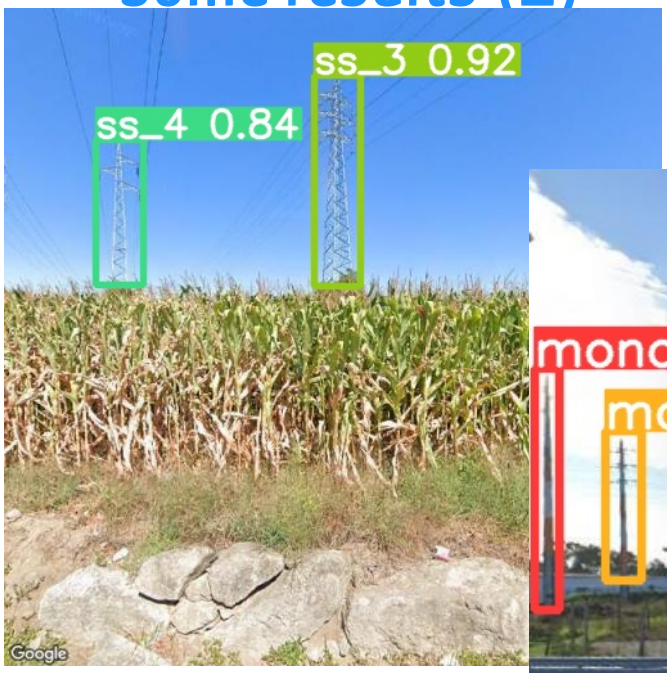
Two tasks

- Identification
- Classification

Task	# Images	Image size	# Classes
Identification	300	512x512	1
Classification	750	512x512	10

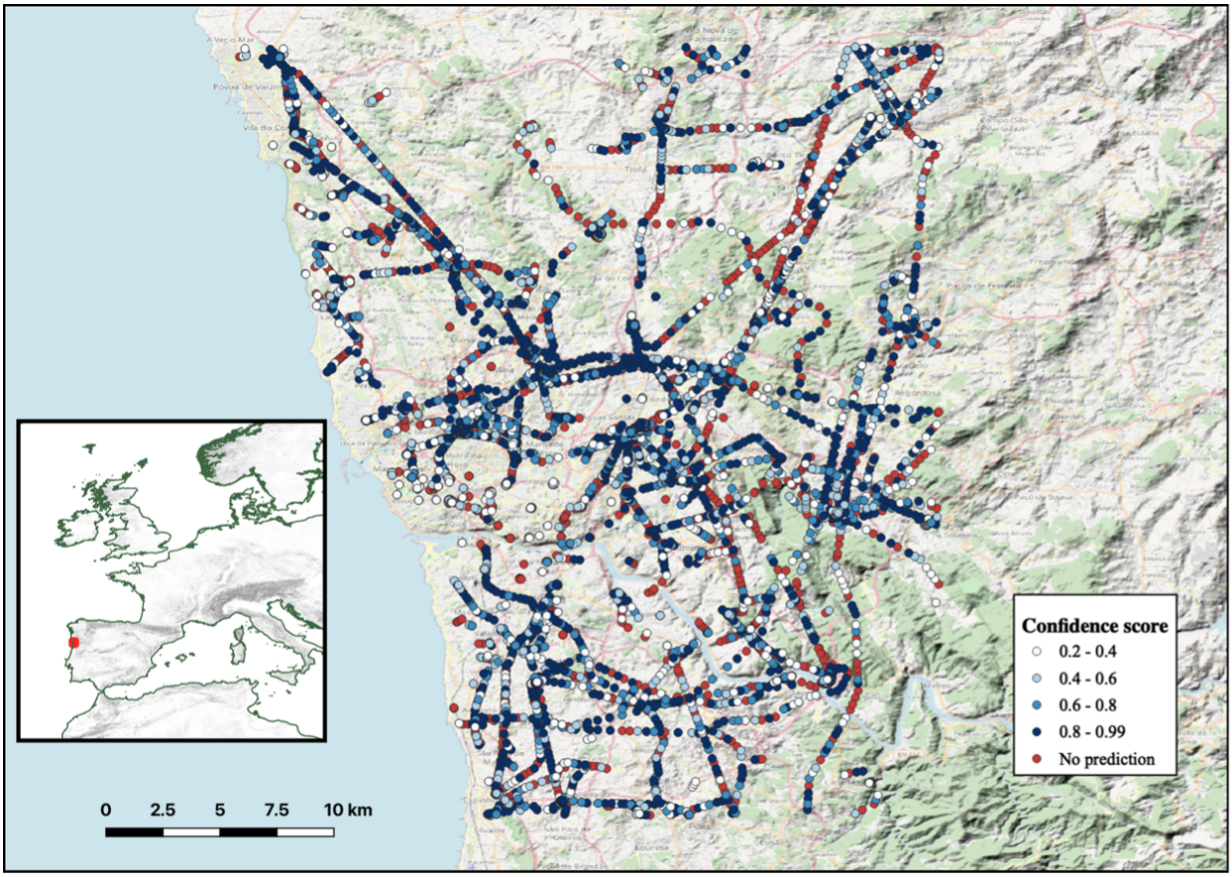


Some results (1)



Mean Average Precision
Identification: 84%
Classification: 51%

Spatial distribution of the predictions



Conclusions/Considerations/Limitations

Case-study related and more general

- Access to a huge amount of data
- GSV costs and hogging of information
- Hard to find training images
- Obstacles in the built environment
- Time consuming annotation of image (automation through supervised algorithm)
- Object agnostic methodology

Reach out

- How a neural network trains
- Single stage and Two-stage detectors
- Architecture of the neural network
- Evaluation metrics
  - Intersection over union
  - AP, AR
  - Small object, big object
- Extraction of height from an image
- Photogrammetry
- Depth map for height