

Human Mapping with Machine Data



 Mapillary

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STATE OF
THE MAP

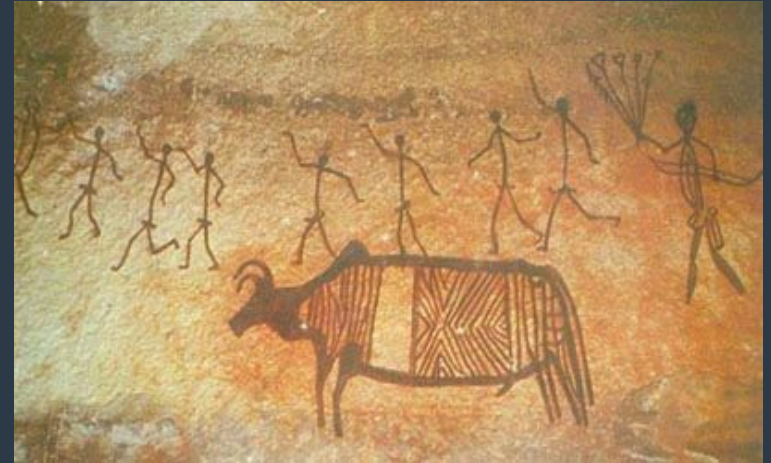


Bridging the Map
Heidelberg 2019

Human Mapping



- ▶ Mapping is:
 - ▶ Cartography, Data collection, Design, Data management, more...
 - ▶ Symbols to make sense of the world
- ▶ By **humans**, for **humans**
- ▶ Maps == tools
- ▶ Humans...
build/design/test/break/invent/imagine
tools
- ▶ Humans do the same with **maps**



Sources

- ▶ Maps are tools built from **data**
- ▶ **Raw, uninterpreted data** is a source of information
- ▶ **Imagery** is not a map: it becomes a map
- ▶ OSM changesets cite the source (imagery)
- ▶ Sources interpreted by human
- ▶ Human is bridge between data & information

Changeset Comment

Add buildings, POIs, parking

Sources

streetlevel imagery × mapillary × aerial imagery ×

local knowledge × survey × gps ×

Add...

Suggested Hashtags

#example...

The changes you upload as cbeddow will be visible on all maps that use OpenStreetMap data.

☐ I would like someone to review my edits.

Cancel Upload

Photo mapping

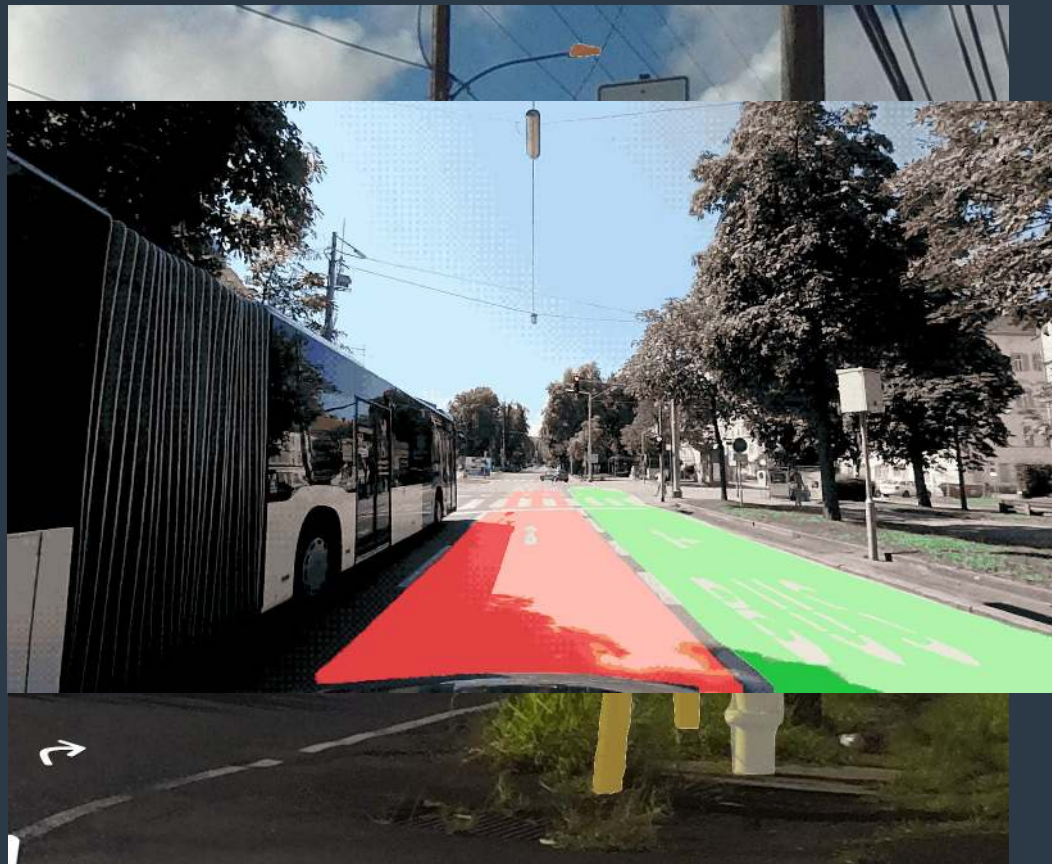


- ▶ Image capture at dense interval gives snapshot of ground level
- ▶ How to use images for mapping?
 - ▶ Geotag, timestamp
- ▶ Upload to Mapillary => view in OSM
- ▶ Fast data collection (10-120 km/h?)
- ▶ Less field time, more desktop time
- ▶ Well suited for temporal studies



Computer Vision

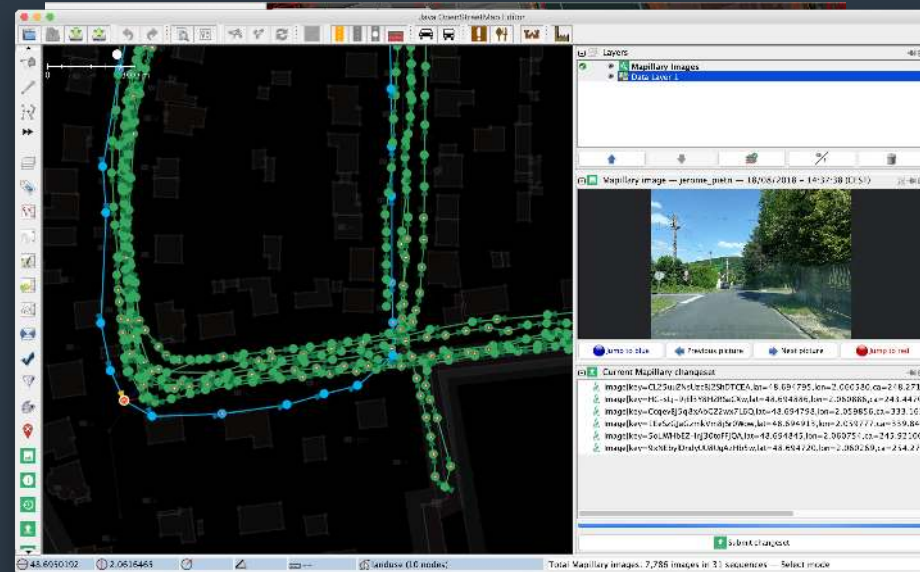
- ▶ Algorithms to interpret images
 - ▶ Training data
 - ▶ Scalable
- ▶ Analyze immense amounts of imagery, in a short time
- ▶ Classify images, 3d scene construction
- ▶ Get the data back to the map



Mapillary ❤️ OSM - A brief history



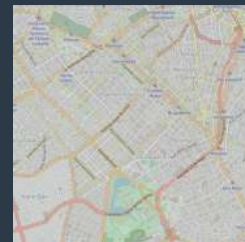
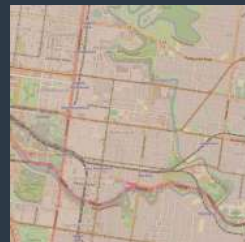
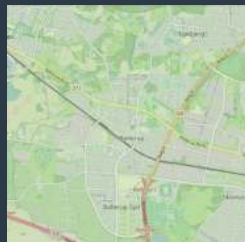
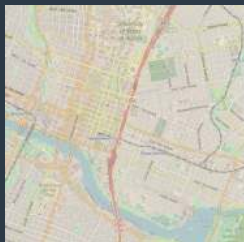
- ▶ Traffic sign layer for iD Editor available since early 2016
- ▶ Traffic sign layer for JOSM available since mid 2016
- ▶ Little visibility into how this data is used to make edits in OSM
- ▶ Willingness from community to improve quality of derived data





- ▶ Experiment in 5 cities to better understand how derived map data is useful in OpenStreetMap
- ▶ 5 locations were selected
- ▶ 25km² area of interest
- ▶ 3 map features provided

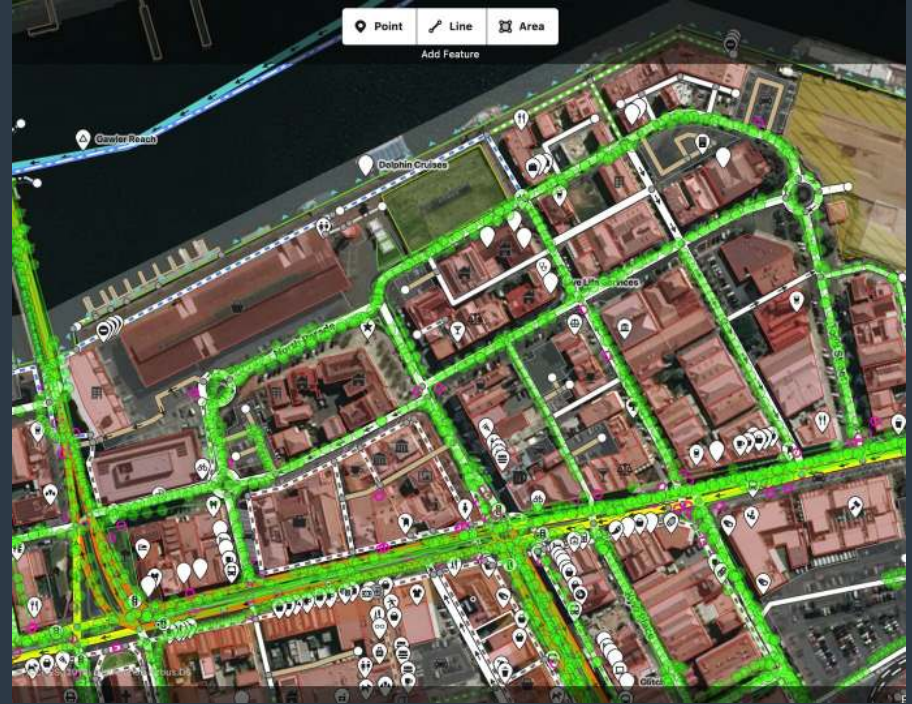
Mapillary						mapillary2osm		
						16 April - 16 May, 2019		
						Read more		
User	Location	post_box	bicycle_parking	bench	Total	Location	Participants	Nodes
velmyshanynyi	kyiv	0	0	242	242	kyiv	4	619
Approximator	kyiv	0	0	228	228	melbourne	1	6
trueVadila	kyiv	1	0	100	101	austin	3	4
Sergey82K	kyiv	2	1	45	48	ballerup	1	2
enaerhut	melbourne	0	0	6	6			
roamingbuffalonian	austin	0	0	2	2			
mids0811	austin	0	0	1	1			
AE35	ballerup	0	0	2	2			
trndq	austin	0	1	0	1			



mapillary2osm



- ▶ Map features loaded directly in iD editor using GeoJSON file
- ▶ GeoJSON file does not store image in which map feature was detected
- ▶ Accuracy dependent on GPS of capture device



Data feedback

- ▶ Not all the icons are intuitive
- ▶ The lat/lon of identified features varies considerably in line with the accuracy of the the camera GPS positions
- ▶ Object classes for humanitarian purposes are limited



False bench detection in Austin

Student Project

- ▶ Analyze area with dense Mapillary data
 - ▶ Pearl District in Portland, Oregon
- ▶ Evaluate data quality by comparing to OSM
 - ▶ Fire hydrants
 - ▶ trash bins
 - ▶ Crosswalks
 - ▶ Benches
 - ▶ Bicycle racks
- ▶ Second item
- ▶ Fourth item

Verifying Mapillary Point Features and Improving OpenStreetMap Data
Mapillary Group
Justin Choi, Justin Han, James Lyou, Clayton Vo
Mapillary
Geography 469
12 June 2019



2,098

Total Points

1193 Points
Visible

904 Points
Non-Visible

59% Accuracy

452

Points Added to OSM

Student Project



False Positives

Benches	Guard Rails, Bus Stops, Chairs, Tables
Waste Baskets	Parking Machines, Newspaper Vending Machines, Mailboxes
Bicycle Racks	Handrails
Crosswalks	Bright splotches of white light

False Positives, Duplicates, Poor image quality

	Visible	Non-Visible	Detection Rate	Total
Bench	288	460	38%	748
Bicycle Racks	241	50	83%	291
Fire Hydrants	400	92	81%	492
Waste Baskets	85	214	28%	299
Crosswalks	179	89	67%	265
Total	1,193	905	57%	2,098

Drawbacks

- ▶ Data not easy to interpret
- ▶ API not easily imported to OSM
- ▶ Irrelevant data classes
- ▶ Variable accuracy and precision
- ▶ Data needs verification, validation
- ▶ No established workflow
- ▶ **How to properly ingest this type of data into OSM?**



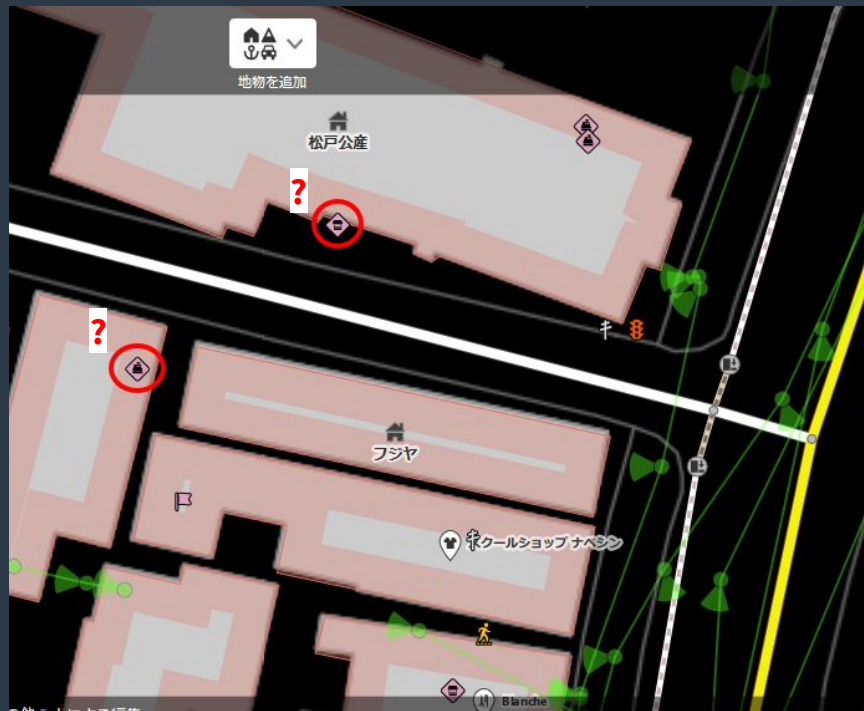
Data Overlay

- ▶ **New experiment:** tile the map features from API
- ▶ Use Mapillary sprites, overlay on OSM id
- ▶ Click icon to show images
- ▶ Add the data to OSM if correct
- ▶ Map features must appear in >3 images




















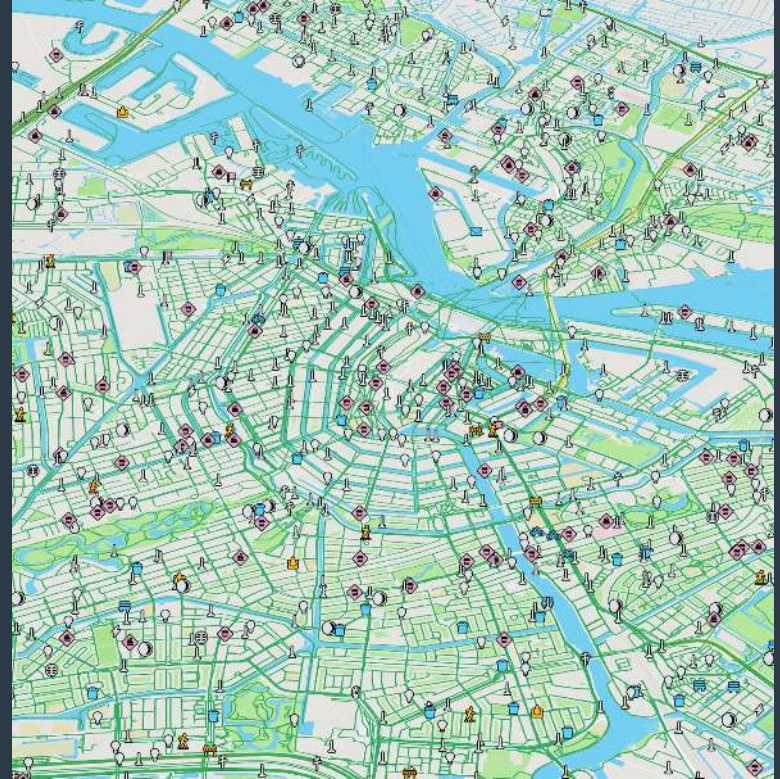
Drawbacks

- ▶ Icons not all intuitive
- ▶ Bad image GPS == bad data position
- ▶ Unverified data == false positives, false negatives
- ▶ Unclear what data is available, and what is not



Available data

- ▶ Bench 
- ▶ Bike rack 
- ▶ Fire hydrant 
- ▶ Mailbox 
- ▶ Phone booth 
- ▶ Street light 
- ▶ Utility pole 
- ▶ Traffic light 
- ▶ Trash can 
- ▶ Crosswalk 
- ▶ CCTV Camera 
- ▶ Banner 
- ▶ Catch basin 
- ▶ Manhole 
- ▶ Advertisement 
- ▶ Information sign 
- ▶ Shop sign 

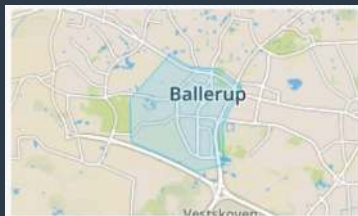


Test Regions

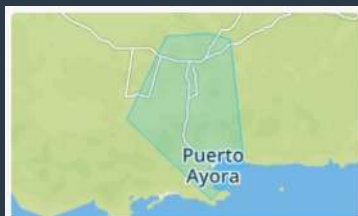
- ▶ Test areas available on request
- ▶ **User requests:** Freising, Tokyo, Ballerup
- ▶ **Mapillary tests:** Madeira, Galapagos, Zanzibar



Madeira



Ballerup



Galapagos



Heidelberg



Zanzibar



Trento



Tokyo-Matsudo area - username higa4



Freising - LukFunk

Test it out

<http://tiny.cc/mapillarytest>



Tools Center Squares Split Continue Delete Undo/Redo Save

INSPECTING Point

Marked Crosswalk

Fields

Type: marked

Tactile Paving: Unknown

Refuge Island: Unknown

Add field: Description, Elevation, Fix Me...

Tags (2)

Relations (0)

Map Data

Data Layers

- ☒ OpenStreetMap data
- ☐ OpenStreetMap notes
- ☐ Keypoint issues
- ☐ Improvements issues
- ☐ Custom Map Data

Photo Overlays

- ☐ King StreetView
- ☒ Mapillary
- ☒ Map Features
- ☐ Traffic Signs
- ☐ OpenStreetCam
- ☒ Flat Photos
- ☒ Panoramic Photos

Fill Areas

Map Features

7 hidden features live Edits by follow, wambacher, Unspoolbox, and 15 others

Request Test



OpenStreetMap Data Request

Please tell us about yourself and your project. This will help us confirm that you are meeting our requirements for open data.

Mapillary map features are not visible on OSM unless the community requests it. Draw an area of interest using the draw tool at bottom right of the map. Please request a reasonable area you want to help map, and not something large like an entire country. It is suggested to start with towns and neighborhoods.

On submitting the form you will be able to agree to Mapillary license terms for OSM, and when we approve the data request you'll be notified. The data will automatically be visible on OSM ID in the area you requested.

First name:

Last name:

Email:

Website (optional):

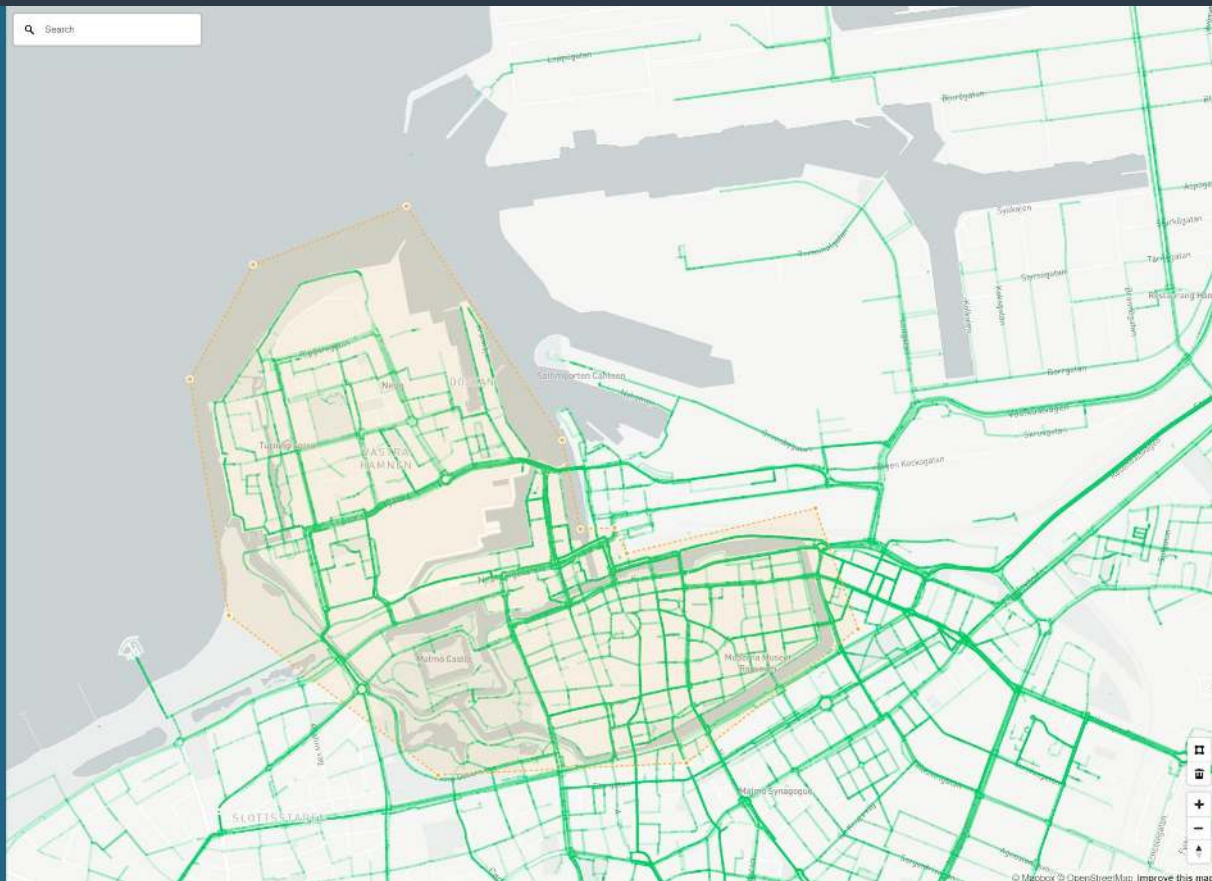
Organization (optional):

OSM username:

Mapillary username:

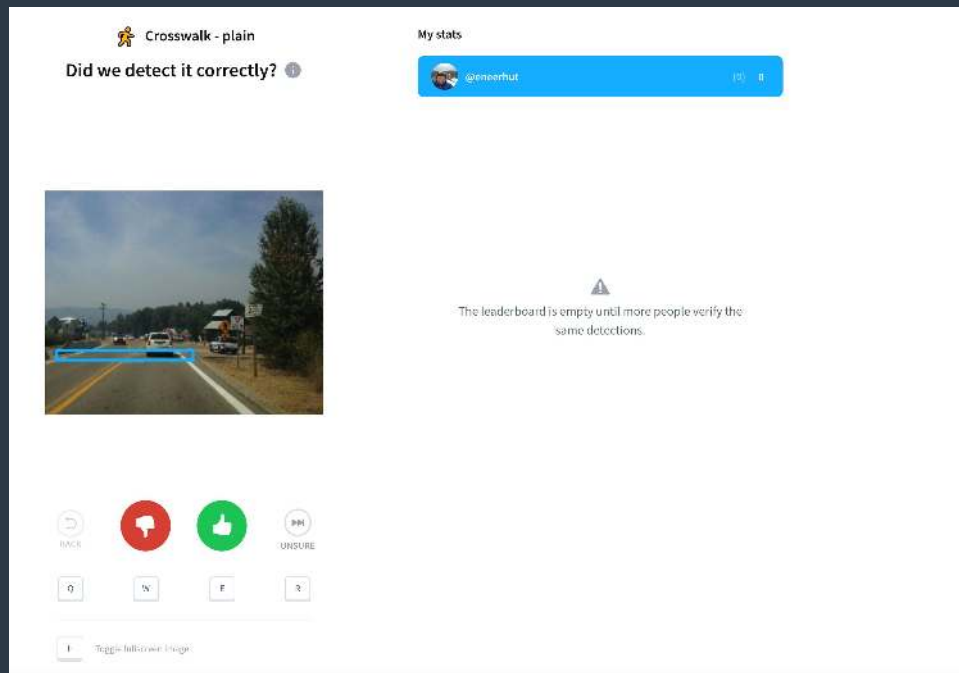
Please describe your project in detail...

Request data



Verification projects

- ▶ Aiming for 1,000,000 verifications
- ▶ 40 object classes
- ▶ Prizes for the top 3
 - ▶ GoPro Hero 7 Black
 - ▶ Blackvue DR900S 1-CH Dashcam
 - ▶ Ticket to the State of the Map of your choice
- ▶ Targeted deadline of October 6th



1. Remove false positives
2. Improve recall for the object class

Other tools

- ▶ Pic4Review
- ▶ Osmose
- ▶ MapRoulette
- ▶ Deriviste
- ▶ Contact us for help
developing any new tools
- ▶ mapillary.com/developer

The screenshot displays the Pic4Review web application interface. The top navigation bar is blue with the Pic4Review logo and a 'Missions' tab. Below the navigation bar, there are filters for 'Sort by' (set to 'New first') and 'Theme' (with icons for different map features). The main content area shows a list of missions, each with a title, location, completion status, and a 'START' button. The missions include:

- Street lights**: Constanța, Romania. 18 % complete (877 features + 3112 without pics). Created 29 days ago - 4 contributors.
- Ajouter le type de caméra de surveillance // Add surveillance camera type**: Auvergne-Rhône-Alpes, France. 64 % complete (26 features + 37 without pics). Created 30 days ago - 2 contributors.
- Crossings using wheelchair**: City of Melbourne, Victoria, Australia. 23 % complete (383 features + 269 without pics). Created 36 days ago - 8 contributors.
- Bus stop type**: Duisburg, Regierungsbezirk Düsseldorf, North Rhine-Westphalia, 47051, Germany. 13 % complete (536 features + 1716 without pics). Created 44 days ago - 4 contributors.
- Brand of fuel station**: Duisburg, Regierungsbezirk Düsseldorf, North Rhine-Westphalia, Germany. 61 % complete (14 features + 46 without pics). Created 44 days ago - 2 contributors.

Each mission card also includes a 'DETAILS' button and a small thumbnail image related to the mission.

What is next?



- ▶ Global verification project - **1 million!**
- ▶ More emphasis on dense capture and community use of capture tools
- ▶ More accurate tracking of Mapillary as a source in OSM
- ▶ Huge amount of data available from each image, but what is relevant?





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@cbe