Human Mapping with Machine Data

Mapillary

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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**
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
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
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
- Map features loaded directly in iD editor using GeoJSON file
- GeoJSON file does not specify image in which map feature was detected
- Accuracy dependent on GPS of capture device
- Not all the icons are intuitive
- The lat/lon of identified features varies considerably in line with the accuracy of the camera GPS positions
- Object classes for humanitarian purposes are limited

False bench detection in Austin
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

Total Points: 2,098

Points Added to OSM: 452

1193 Points Visible, 904 Points Non-Visible

59% Accuracy
**Student Project**

### False Positives

<table>
<thead>
<tr>
<th>False Positives</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benches</td>
<td>Guard Rails, Bus Stops, Chairs, Tables</td>
</tr>
<tr>
<td>Waste Baskets</td>
<td>Parking Machines, Newspaper Vending Machines, Mailboxes</td>
</tr>
<tr>
<td>Bicycle Racks</td>
<td>Handrails</td>
</tr>
<tr>
<td>Crosswalks</td>
<td>Bright splotches of white light</td>
</tr>
</tbody>
</table>

### False Positives, Duplicates, Poor Image Quality

<table>
<thead>
<tr>
<th>False Positives</th>
<th>Visible</th>
<th>Non-Visible</th>
<th>Detection Rate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bench</td>
<td>288</td>
<td>460</td>
<td>38%</td>
<td>748</td>
</tr>
<tr>
<td>Bicycle Racks</td>
<td>241</td>
<td>50</td>
<td>83%</td>
<td>291</td>
</tr>
<tr>
<td>Fire Hydrants</td>
<td>400</td>
<td>92</td>
<td>81%</td>
<td>492</td>
</tr>
<tr>
<td>Waste Baskets</td>
<td>85</td>
<td>214</td>
<td>28%</td>
<td>299</td>
</tr>
<tr>
<td>Crosswalks</td>
<td>179</td>
<td>89</td>
<td>67%</td>
<td>265</td>
</tr>
<tr>
<td>Total</td>
<td>1,193</td>
<td>905</td>
<td>57%</td>
<td>2,098</td>
</tr>
</tbody>
</table>
**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
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
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?
GoPro Raffle - Sunday
time & place TBD

@mapillary