Smartphone based Road Infrastructure Inspection

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The Challenge

- Inspecting city roads **manually** is a tedious and error-prone.
- Using **specialized vehicles** gives accurate results but is expensive.
- **Citizen reports** are unreliable and address only major problems.

Distributed data collection

Proposed system: Imaging is done with a portable Android device mounted inside a vehicle.

Obtain time-stamped images, GPS, accelerometer, compass and gyroscope measurements city-wide, on a regular basis

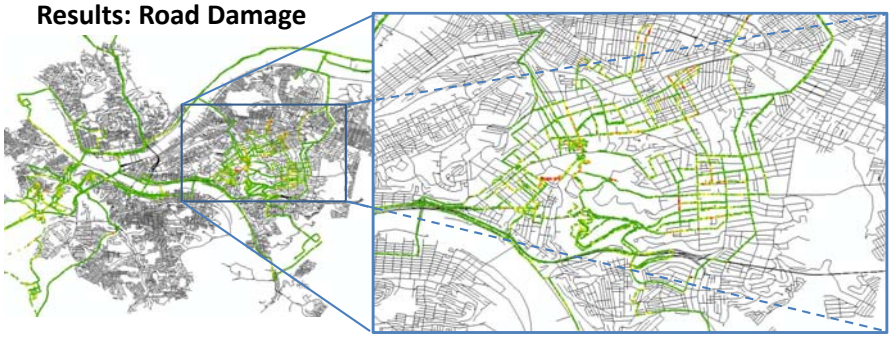
Can be used in service vehicles - no special personnel required for data collection

Identify cracked regions

Input image is from the passenger's point of view.

Classification using segmentation of ground [1], SLIC segmentation [2], bag-of-words, and support vector machines.

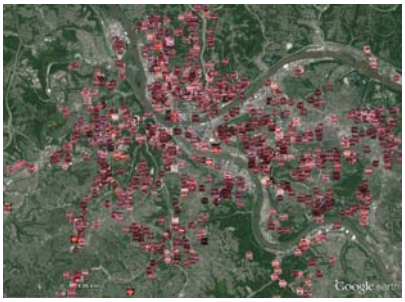
Results: Road Damage



Severity: Low Medium High

Scores from running the algorithm on ~25k images captured city-wide, on a map of Pittsburgh

Stop sign inventory and assessment



Stop signs detected in the city of Pittsburgh.

- 1500 km unique roads
- 3 years
- 500 hours
- 14M images

Stop signs with problems:

sticker

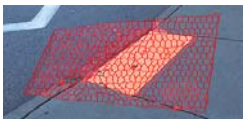
occluded by vegetation

graffiti

displaced

Ongoing work 2016

General traffic sign detection using a boosted Haar cascade classifier and synthetic images for initial training



The texture detection software can also be trained to **find tactile patches in sidewalks.**

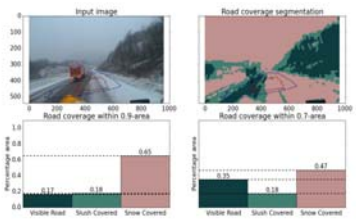
Measuring size of traffic sign (left) using GPS and **visual odometry** (right) to scale the detected sign in the image.

flash on flash off subtracted

Subtract image with flash off from image with flash on to **measure retroreflectivity of the traffic sign**.

Inspection Possibilities

Road condition: Snow and slush cover



Prove of principle completed.

Lane marker assessment

Problem area

Recently started work.

Partners

PennDOT: Road Condition Reporting

City of Pittsburgh and Marshall, Cranberry, Penn, and North Huntingdon Townships: Road and sign assessment pilot test

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References

[1] Hoiem, Derek, Alexei A. Efros, and Martial Hebert. "Geometric context from a single image." Computer Vision, 2005. ICCV 2005. Tenth IEEE International Conference on. Vol. 1. IEEE, 2005.
[2] Radhakrishna, A., et al. Slic superpixels. Vol. 4. Technical report, EPFL, 2010.