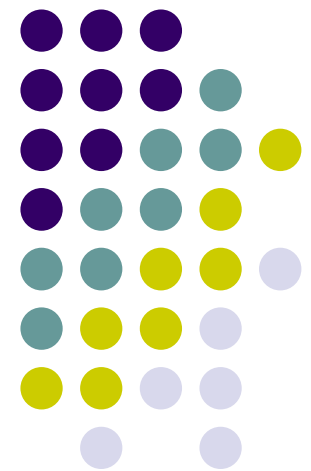


COMMUNISENSE: Crowdsourcing Road Hazards in Nairobi

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Outline

- Introduction
 - Potholes (PT) & Speed-bumps (SB)
- Methodology
- Results
- Novelty and Challenges
- Critiques



Introduction

- Motivation
 - Nairobi currently **lacks** monitoring technologies to obtain data on road conditions.
 - Such as Potholes and/or Speed-bump.



Introduction

- Road hazard: Potholes (PT)



(a) Potholes



Road Hazard Examples

- Road hazard: Speed-bump (SB)



(b) Speed Bumps



Outline

- Introduction
- Methodology
 - Survey
 - The App: CommuniSense
 - Image Verification: MTurk
- Results
- Novelty and Challenges
- Critiques



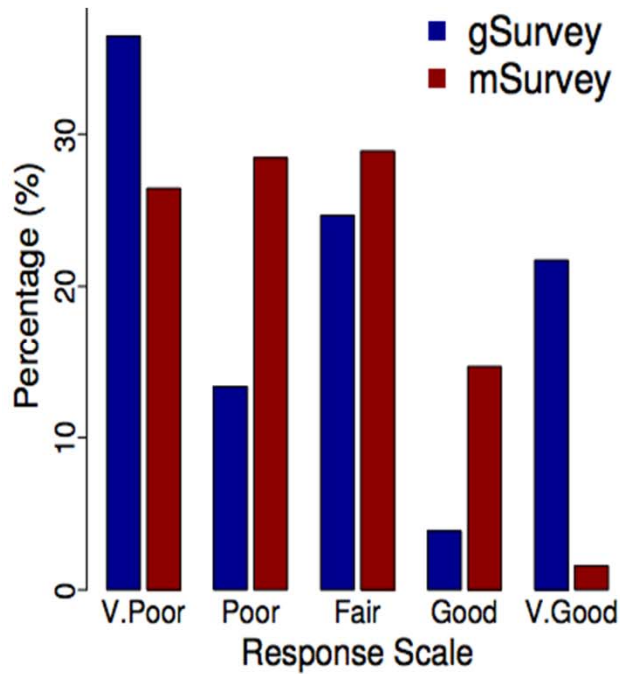
Methodology

- Two types of survey
 - SMS (mSurvey)
 - Web-based (gSurvey)
- On the opinions of road situation
 - Road quality around home/work
 - Impact of road hazards

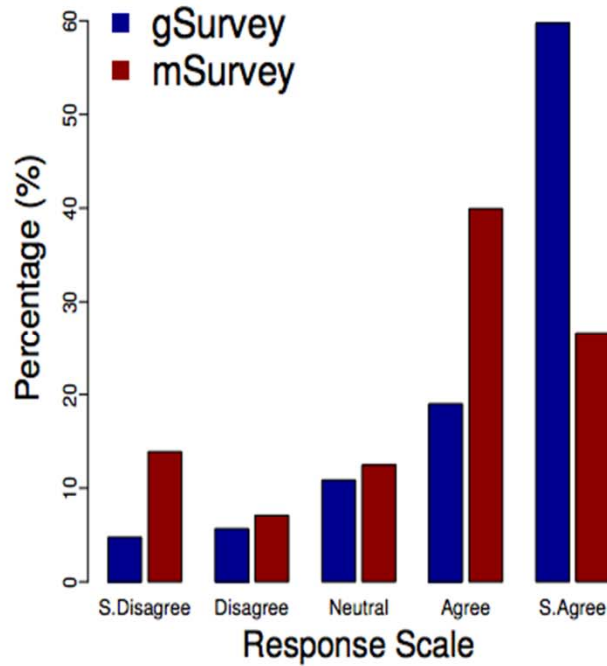
Survey



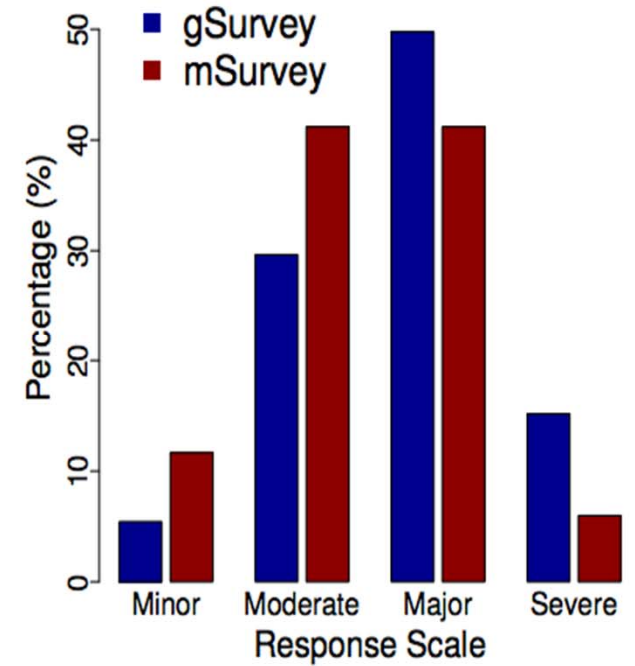
- Status quo on road quality



Road quality in residential neighborhood



Potholes as a major road nuisance

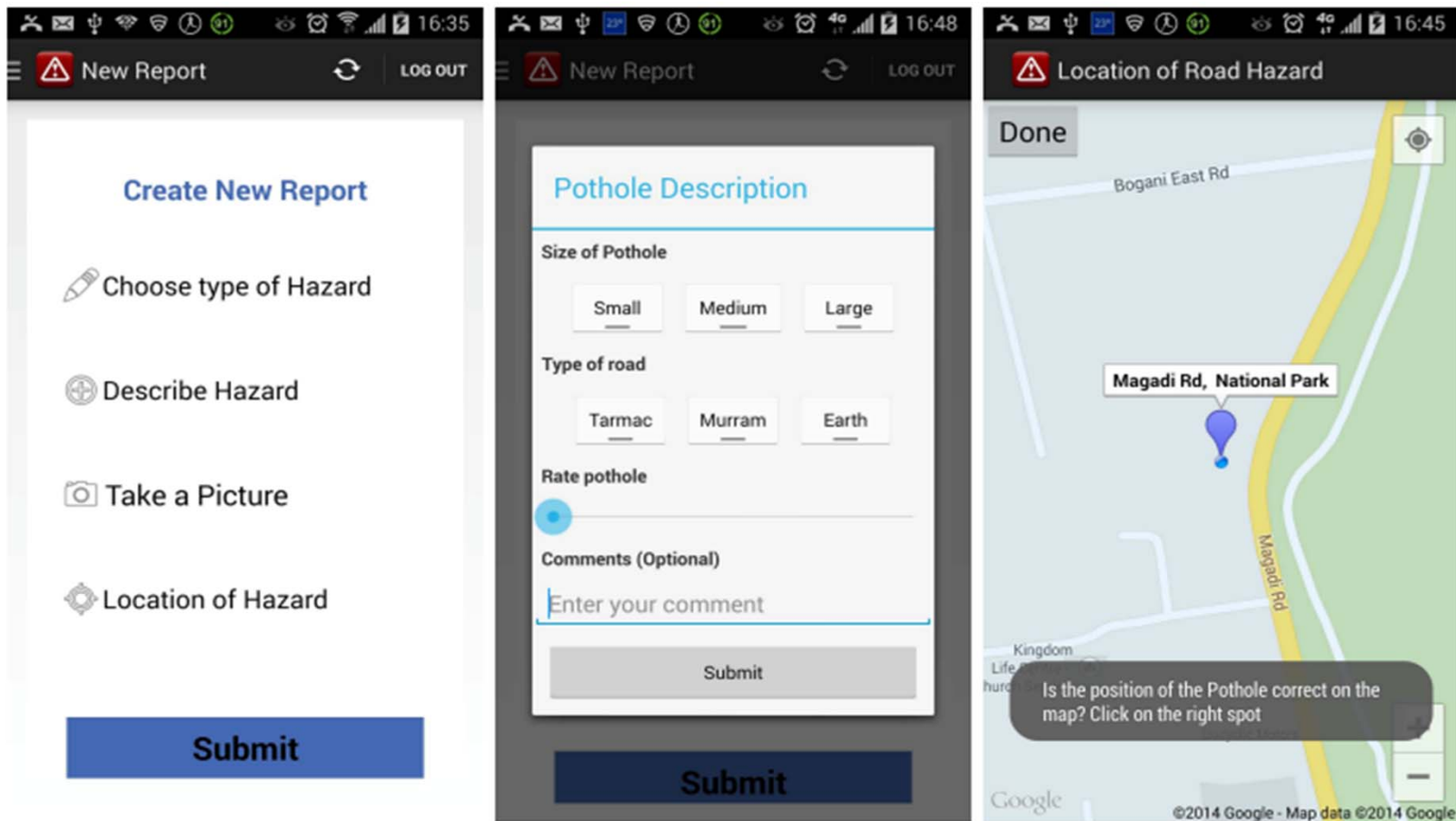


Impact of road hazards on personal travel discomfort



CommuniSense Frontend

- CommuniSense: Hazard report submission

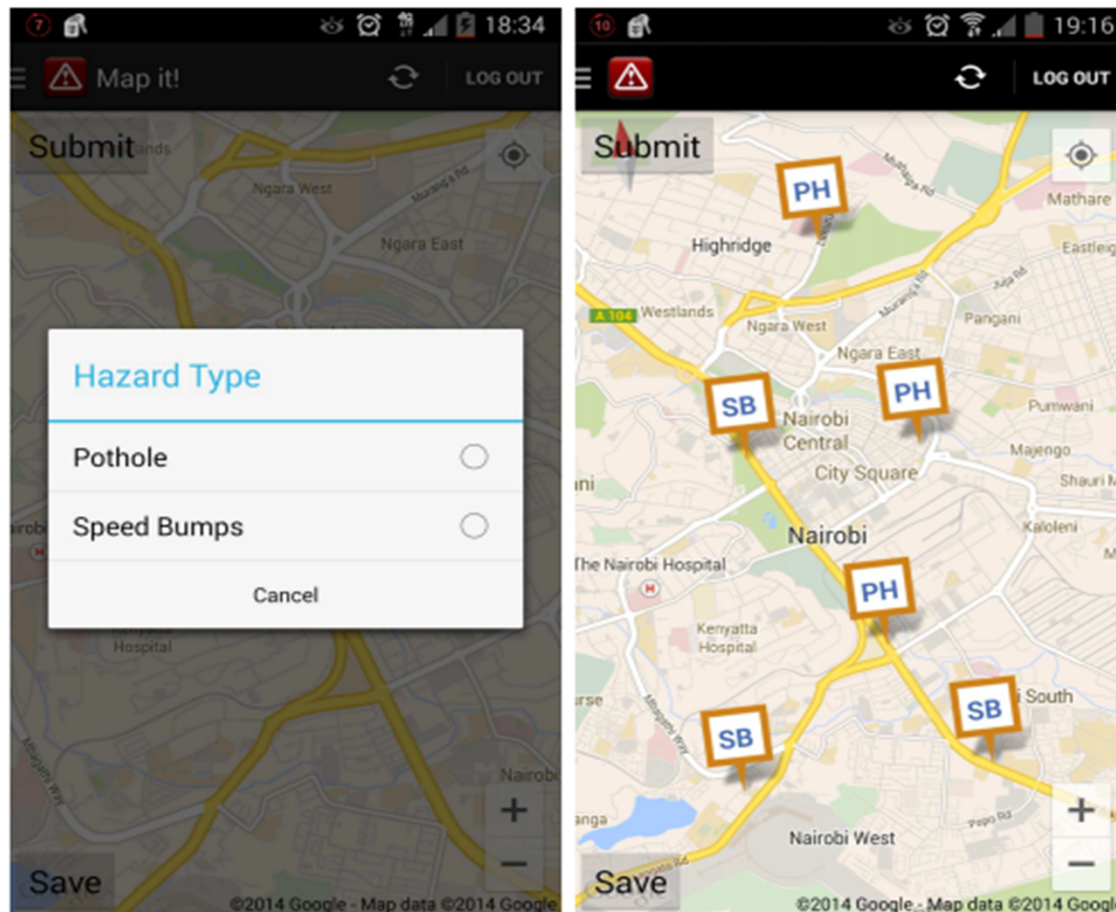


(a) Hazard Report Submission



CommuniSense Frontend

- CommuniSense: Mapping hazards

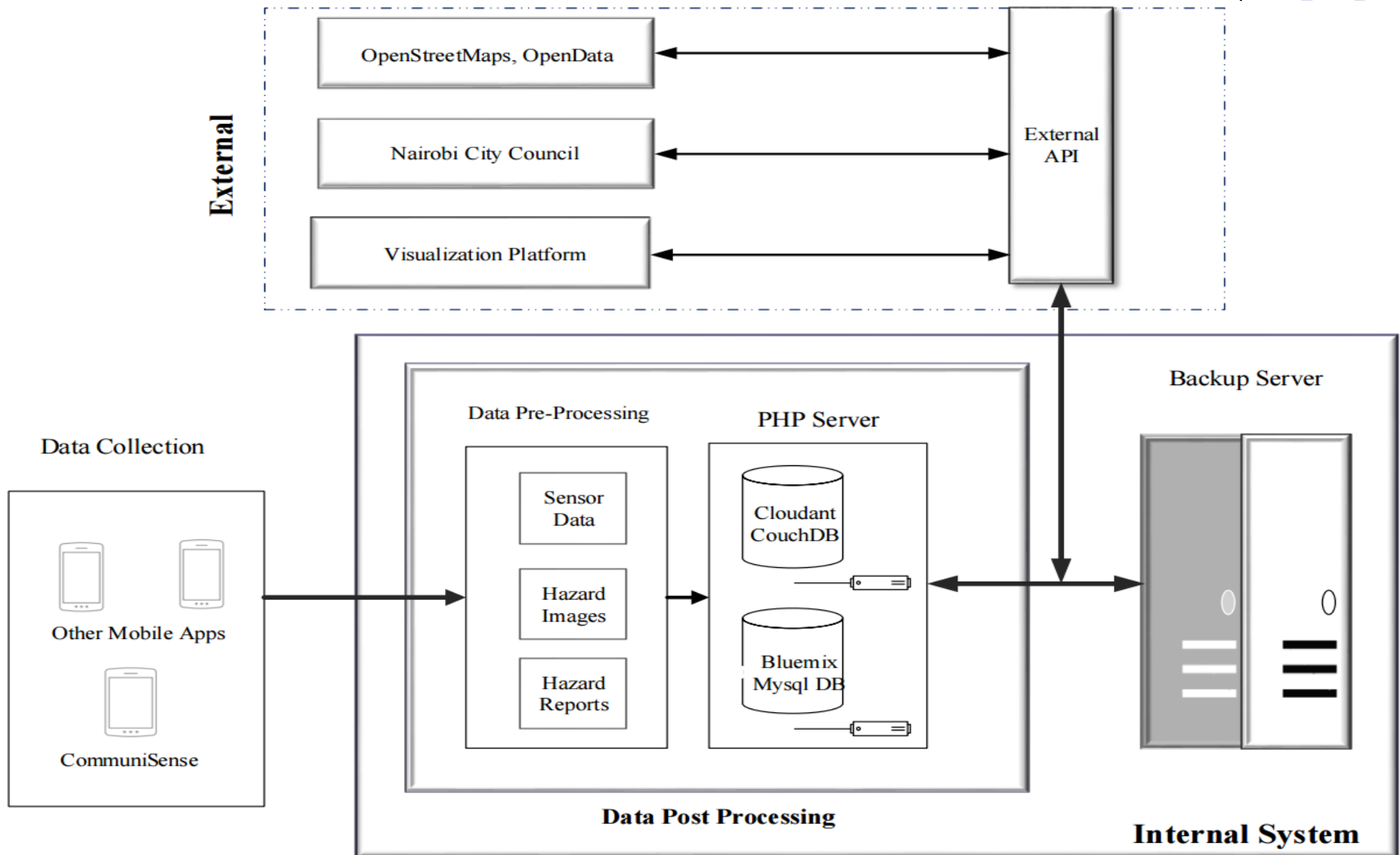


- PH: Potholes
- SB: speed-bumps

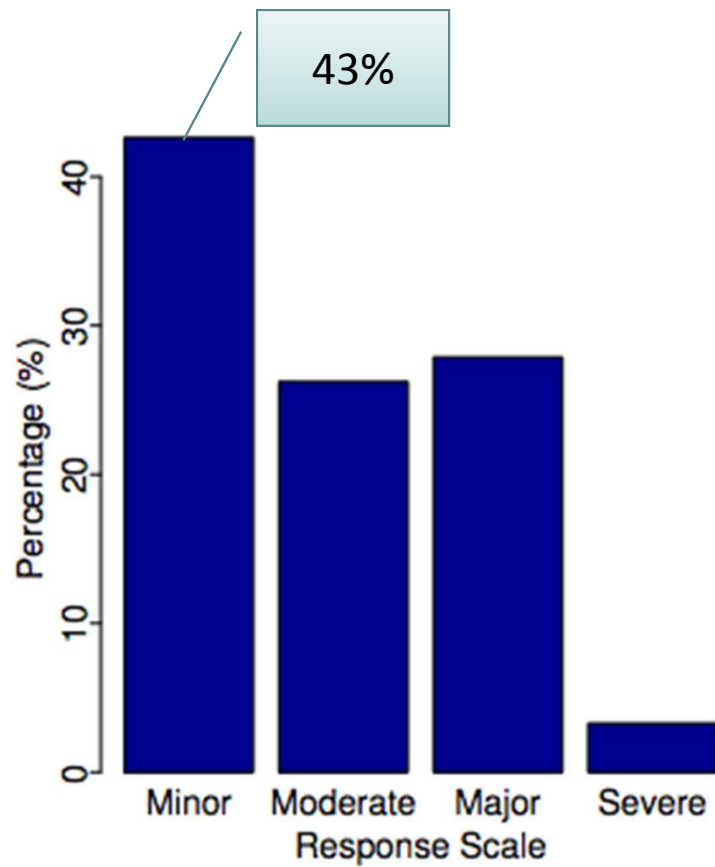
(b) Mapping Hazards



CommuniSense Backend

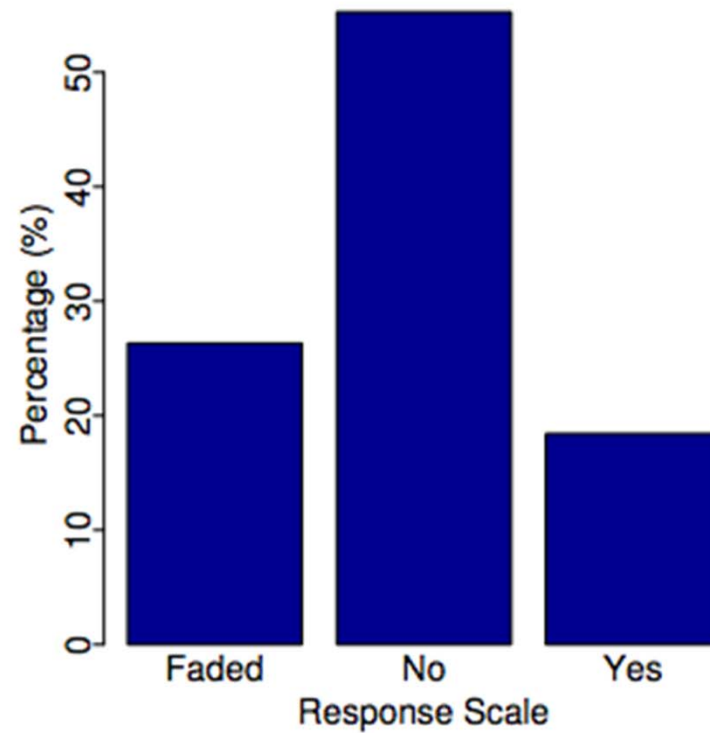


Data Statistic



(a)

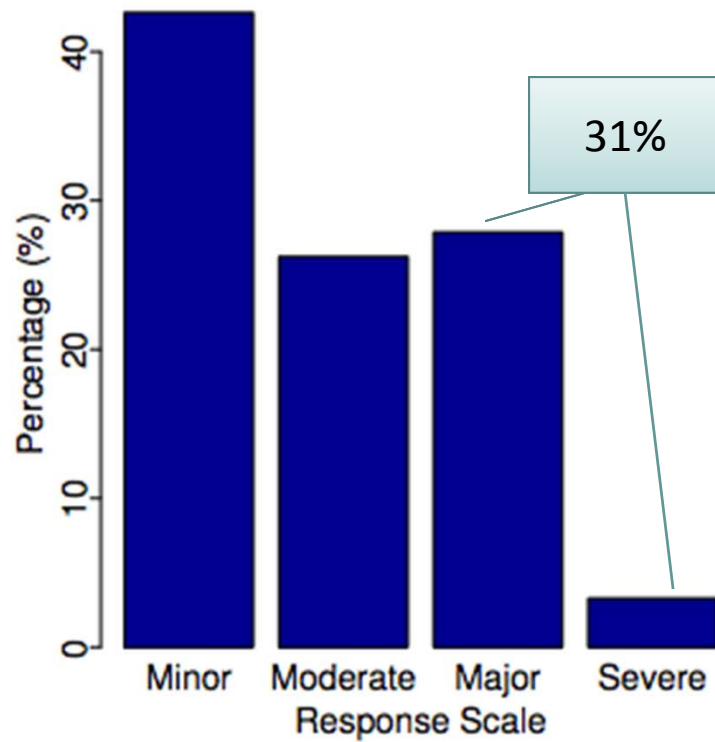
Severity of potholes
(61 reports)



(b)

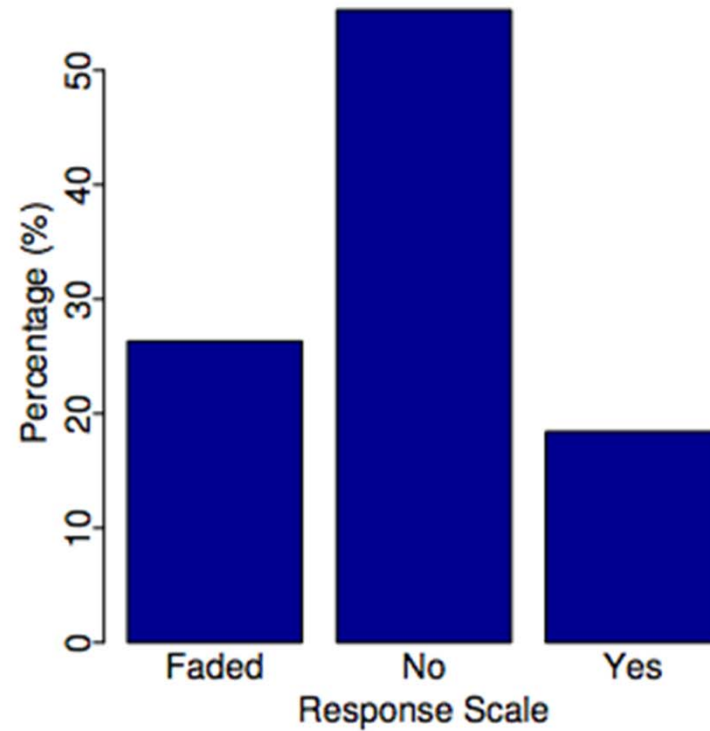
Labeling of speed-bumps
(38 reports)

Data Statistic



(a)

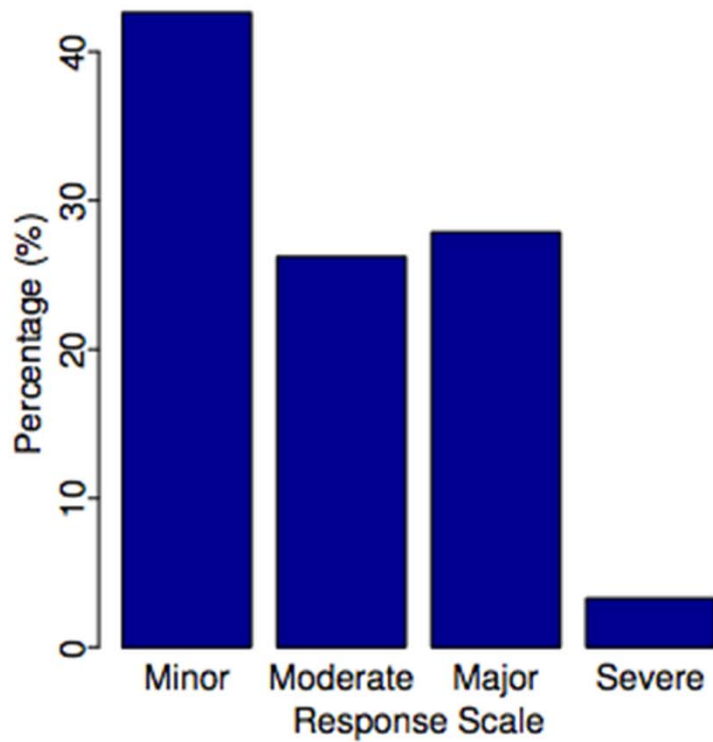
Severity of potholes
(61 reports)



(b)

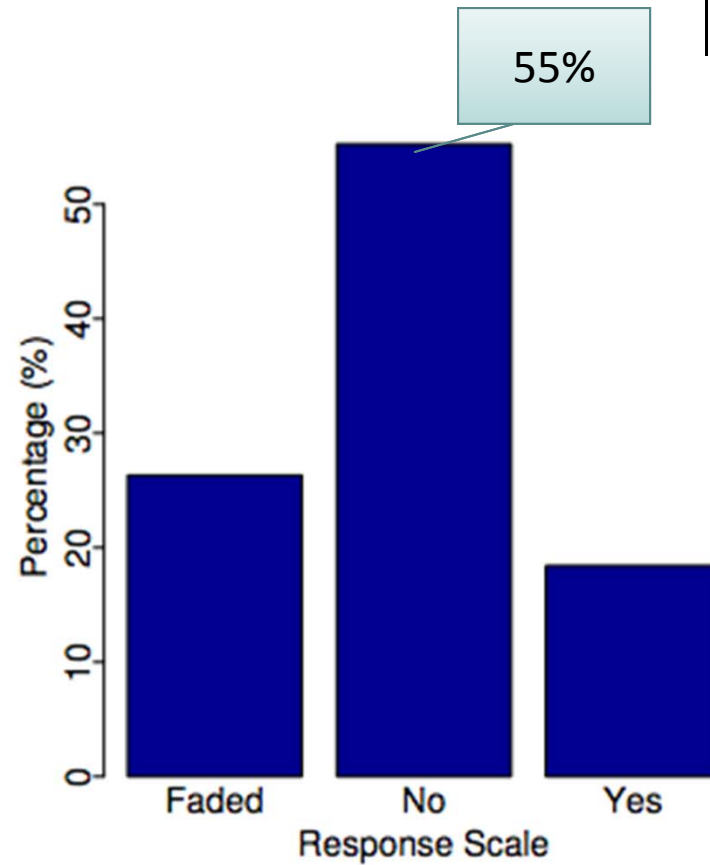
Labeling of speed-bumps
(38 reports)

Data Statistic



(a)

Severity of potholes
(61 reports)



(b)

Labeling of speed-bumps
(38 reports)



Image Verification: MTurk

Mechanical Turk is a marketplace for work.

We give businesses and developers access to an on-demand, scalable workforce. Workers select from thousands of tasks and work whenever it's convenient.

395,733 HITs available. [View them now.](#)

- HIT: Human Intelligence Task
- 0.15 USD per Image, around \$12 per hour.
- Required to check the description and the pictures are corresponding to each other.



Outline

- Introduction
- Methodology
- Results
 - Two Aggregation Methods
 - Intraclass Correlation (ICC)
 - OpenStreetMap (OSM)
- Novelty and Challenges
- Critiques



Results: Image Label Quality

- Aggregation methods:
 - Majority Vote
 - Calculate the majority score given the 10 annotations for each image
 - Median
 - Calculate the median across the 10 annotations for each image.
 - Among 50 images:

Method	Potholes	Speed Bumps
Majority Voting	34 (100%)	12 (75%)
Median	34 (100%)	12 (75%)



Results:

- Misclassified Images



(a)

Contain both a pothole and a speed-bump



(b)

Ambiguous Image with unlabeled bump



Results: Image Label Quality

- **I**ntraclass **C**orrelation (ICC)
 - Also implemented by Amazon Mturk worker pool.

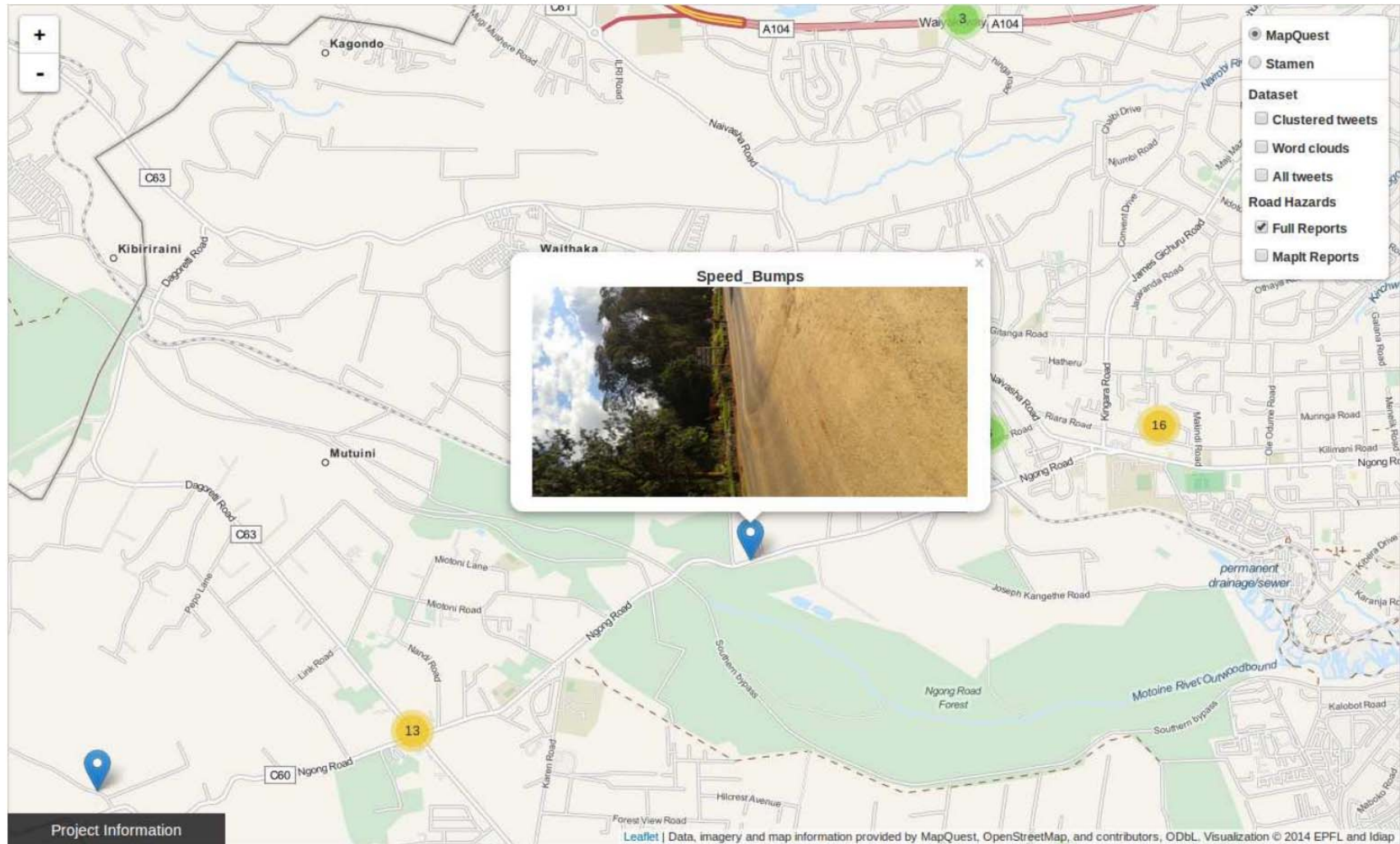
	Min (Max)	Mean (Median)	$ICC(1, k)$
Size of potholes	1.0 (3.0)	2.16 (2.0)	0.90
Severity of potholes	1.0 (4.0)	2.26 (2.0)	0.91
Size of speed-bumps	1.0 (3.0)	1.92 (2.0)	0.73

Table 2: $ICC(1, k)$ scores of hazard attributes (All values are statistically significant at $p < 0.01$.) Mean and median (in brackets) values of each hazard attribute is also shown.



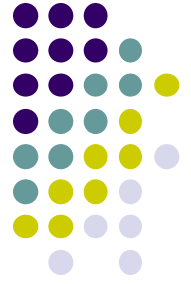
Results: Visualization Framework

- OpenstreetMap (OSM): layered and interactive



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- *Novelty and Challenges*
- Critiques





Novelty and Challenges

- **Novelty and Future Work**

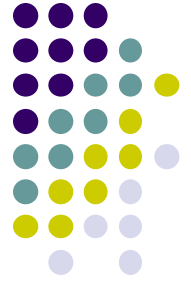
- Most similar systems are not available for Nairobi.
- May use Twitter as a data collection medium in the future.

- **Challenges:**

- Certain devices didn't handle the mapping and location functionality well.
- CommuniSense is developed on Android 3.0, while many phones are still using Android 2.x.
- The *base64* compression causes loss of image dependent on the orientation (landscape vs. portrait mode).

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Critiques



- Simple App
- Good solution for Kenya. No good alternative, only a Twitter account called *ma3route*.
- May be used in other areas.



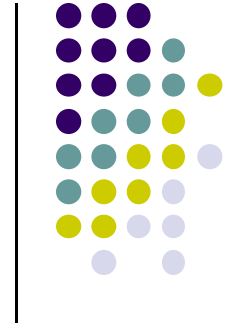
Critiques

- Use Mturk (slave labors). Should find an automatic way.
- Exist systems which allow citizens to report civic issues
 - SeeClickFix
 - FixMyStreet
 - Citizens Connect



References

- Citizens connect: Making boston beautiful. <http://bit.ly/1a4asN3>, 2014. 5.
- Fixmystreet. <https://www.fixmystreet.com>, 2014.
- ma3route. <https://twitter.com/ma3route>, 2014.
- Seeclickfix. <http://seeclickfix.com>, 2014.



Thank You