

Title: Scalable Image Based Localization

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1

Drawbacks of existing approaches to localization such as GPS and cell tower triangulation:

- Not accurate to pixel level
- Do not provide orientation

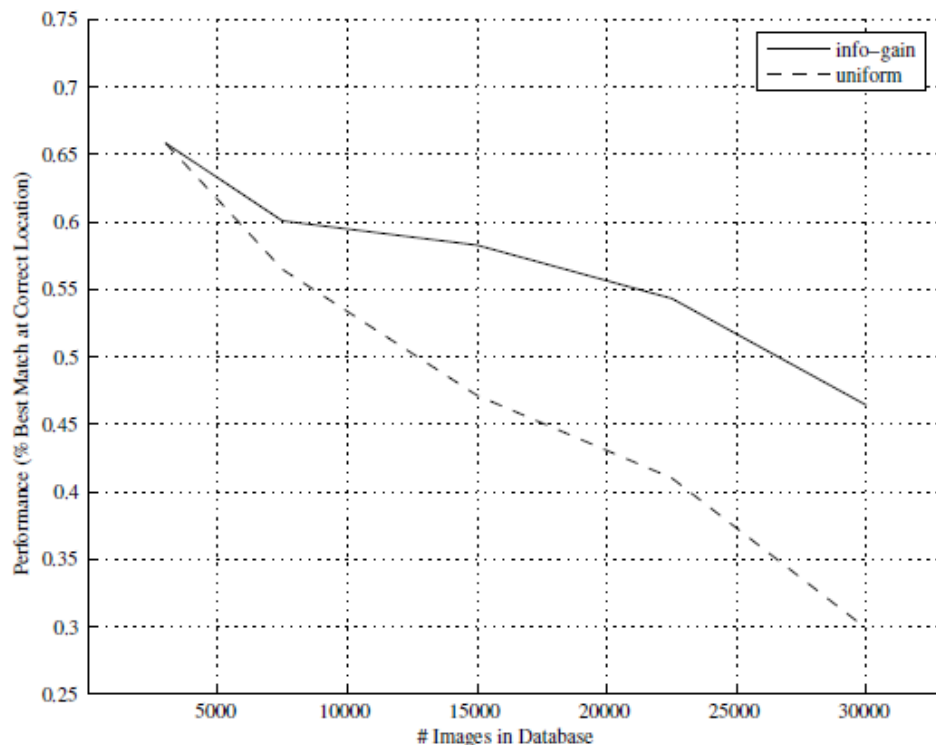
Recover user's location by matching user's image with a geo-tagged image database

Need Large image databases:

- Street View from Google,
- Bing maps from Microsoft,
- Earthmine, etc
- Crowdsourcing



G. Schindler, M. Brown, and R. Szeliski, "City-Scale Location Recognition," in CVPR, 2007.

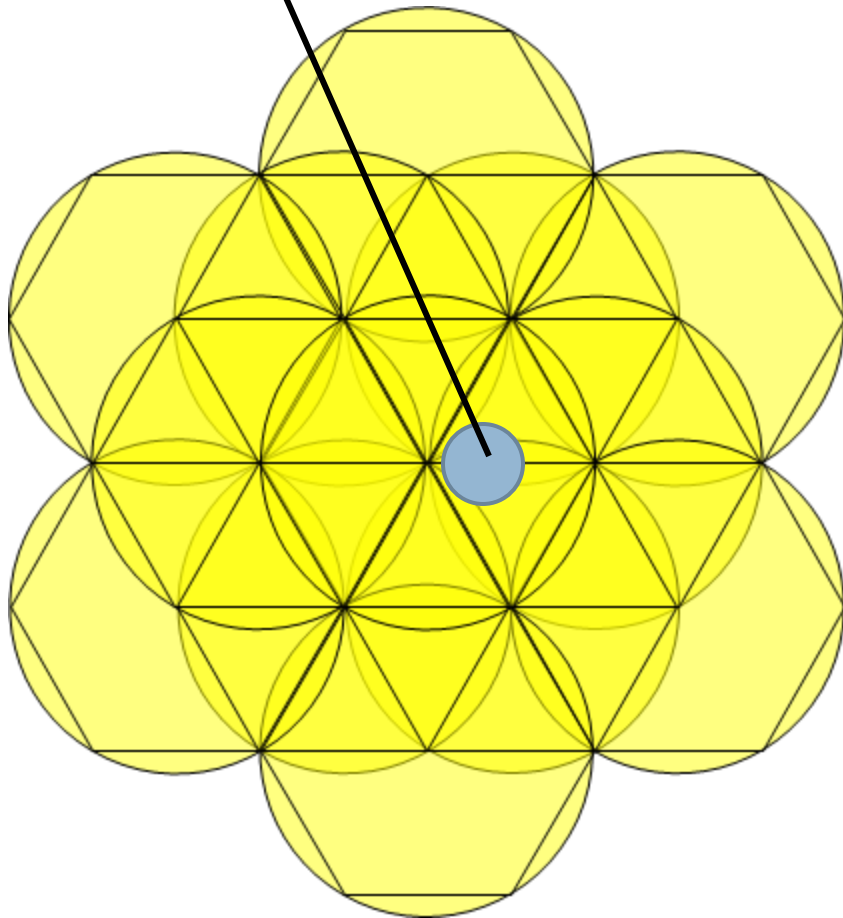


Performance of image retrieval based Localization degrades with the size of images in the database

Divide and Conquer → Scalable

2

ambiguity circle



- Divide a large geographic area into overlapping circular “cells”
 - ▣ Centered at vertices of hexagonal lattice
 - ▣ Similar to “handoff” in wireless carriers
- Each cell has its own image based search/retrieval engine
- Coarse location reported by cell phone:
 - ▣ GPS or cell tower triangulation
 - ▣ Actual location is within *ambiguity circle* centered around reported location

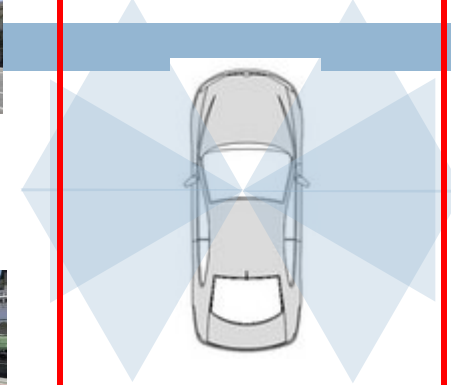
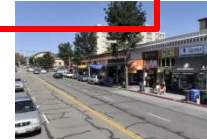
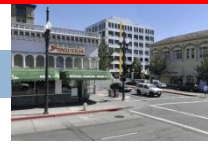
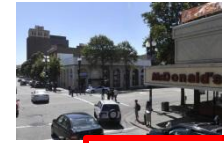
Data Sources

Image Database:

- ~ 2000, 360 degree panoramic images of downtown Berkeley
- Processed into ~12000 geo-tagged 768x512 “street-view” images
- One square kilometer
- 25 cells of radius 236 m
- ~ 1500 images per cell

Query Set

- Camera SLR Nikon camera D40x w/ 18-55mm lens:
 - ~ 90 landscape images per set
- Cell phone camera
 - HTC Droid Incredible
 - 8 megapixel camera, autofocus, focal length 4.92mm
 - ~ 110 portrait images per set



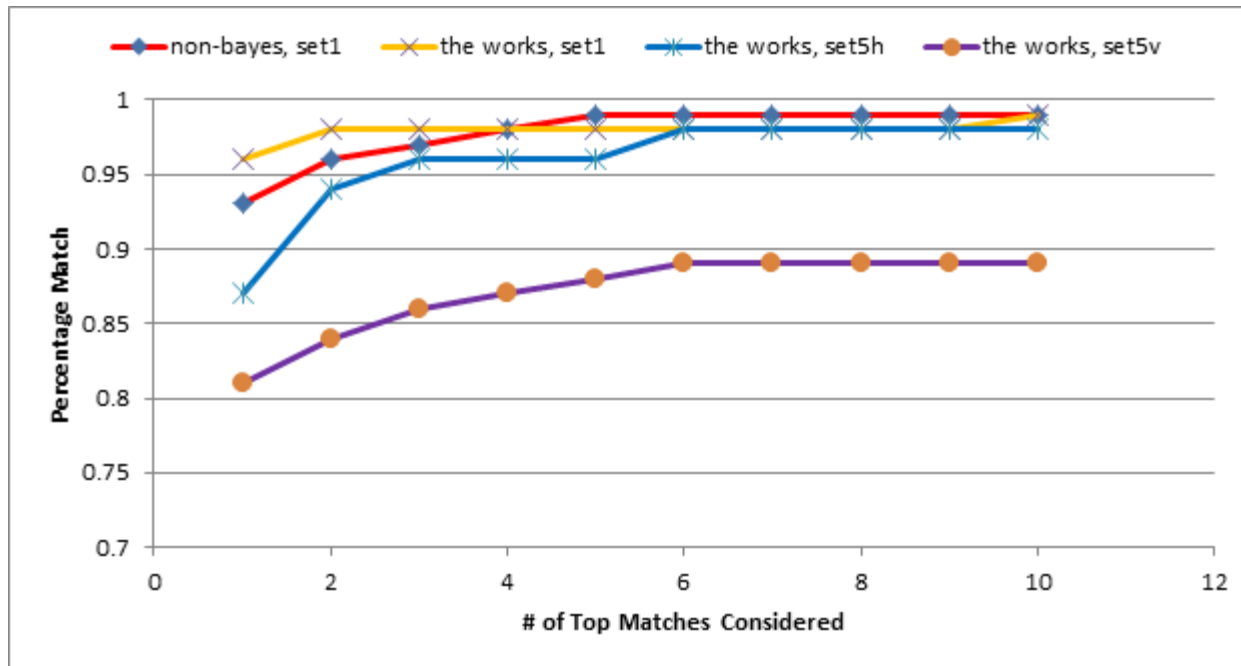
Cell phone



Digital Camera

Experimental Setup and Results

4



Causes of Failure:

- Query pictures taken close-up often with shadows
- Heavily obscured by tree branches
- Not a correct pose match in the db
- Matched common objects

Transfer Tags onto Query Image

5

