Verifying Truth from the Ground: Leveraging Human Strengths in the Image Geolocation Process

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Abstract:
Photo and video verification is a key step in investigations in fields such as journalism, human rights advocacy, and intelligence analysis. We focus on a subset of image verification, image geolocation, in which expert investigators work to identify the exact geographic location where a photo or video was made. This manual process does not scale easily, and experts are often overwhelmed by the amount of information they must process. Furthermore, computer vision-based geolocation techniques are not yet sufficiently precise, accessible, or generalizable. In prior work, we built GroundTruth, a system that allows novice crowd workers to help expert geolocators search an area of satellite imagery. Our current work investigates the real-world value and implications of systems like GroundTruth. In one study, we are exploring how experts collaborate with crowd workers in real time, and to what extent they trust crowd feedback. In a second study, we are comparing GroundTruth and Humanitarian OpenStreetMap to understand how conceptions of localness affect success in geographic crowd work.

Keywords:
crowdsourcing; geolocation; bias; geographic HCI; journalism; open source investigation; sensemaking; verification

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Introduction

Photo and video verification is a key step in investigations in journalism, human rights advocacy, and disaster response. We focus on a subset of image verification, geolocation, in which expert investigators work to identify the exact geographic location where a photo/video was made [1]. This manual process does not scale easily and experts are often overwhelmed by the amount of information they must process [2]. Furthermore, computer vision-based geolocation techniques are ineffective because they are not generalizable.

Completed Work

Crowd Performance in Image Geolocation

Motivation

Geolocation is a largely manual process and experts often spend hours or days searching for an image in satellite imagery. They are overwhelmed by the amount of images they must geolocate and are unable to scale.

Research Questions

RQ1: With what level of detail does the crowd perform best?

RQ2: Does the crowd perform better with a ground-level photo, an aerial diagram, or both?

RQ3: How fast can the crowd reduce the search space?

Method

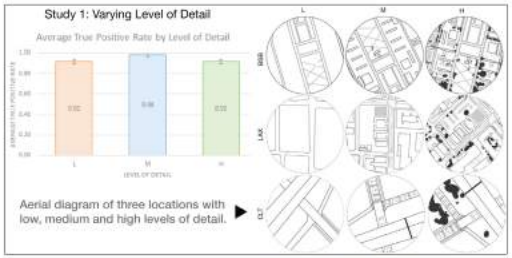
We adapted an expert diagramming technique to overcome spatial reasoning limitations of novice crowds, allowing them to support an expert's search. We considered how this diagramming technique can be adapted for crowds who lack an expert geolocator's spatial thinking skills [1].

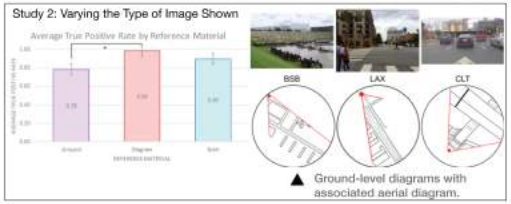
Results

1. The crowd performed best with a medium level of detail.

2. The crowd performed significantly better with aerial diagram than with ground-level image.

3. The crowd reduced the search area by 50% in 10 minutes, without expert intervention.





Our System: GroundTruth

GroundTruth is a web-based system that enables experts to designate a search area for crowdworkers to investigate in parallel and then review the aggregated results for a potential location match.

In Progress

Study 1: User Study with Expert Geolocators

Motivation

Our prior work has shown that crowds are effective at image geolocation. However, it is not known if experts will listen to and trust crowd feedback or if they prefer their current practices over one that involves crowds.

Research Questions

RQ1: How do expert geolocators collaborate with the crowd in real-time?

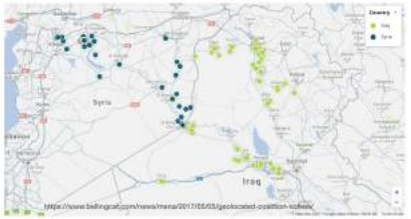
RQ2: How does GroundTruth fit in to current expert practices?

Method

Using a think-aloud protocol, we will observe expert geolocators as they use GroundTruth to geolocate images from a computer vision-based image geolocation dataset. This will allows us to gain insights into how they collaborate with the crowd. We will follow this up with a semi-structured interview.

Expected Results

- Successful geolocation outcomes and a positive overall experience, resulting in a strong preference for GroundTruth.
- Insights into how experts collaborate with crowds on geolocation taks, and generalized design implications.
- Facilitating a higher rate of image geolocation by scaling expertise with the help of the crowd, thereby combating the spread of misinformation.



▲ Crowdsourced Geolocation and Analysis of Coalition Airstrike Videos from Syria and Iraq

Study 2: Exploring Geographic Biases in Crowd Work

Motivation

Geographic crowd work is crucial to Humanitarian OpenStreetMaps, Uber, crowdsourced geolocation, and other domains.

However, the geographic nature of this work may be influenced by differences in human geographic knowledge and familiarity.

Crowdsourced Maps Assist in Hurricane Maria Relief Efforts: How Volunteers are Helping Put Puerto Rico on the Map

Research Questions

RQ1: Does distance-based localness affect an individual's success at geographic crowd work?

Urban/Rural \ Location	Minnesota	Virginia
Urban	Urban Minnesota	Urban Virginia
Rural	Rural Minnesota	Rural Virginia

RQ2: Does density-based localness affect an individual's success at geographic crowd work?

Method

In two high-stakes domains, we focus on understanding the correlation between distance-based localness and success, and density-based localness and success. In both cases, we seek to predict or experimentally verify success based on how far away a contributor is from a given area, and the demographic information about that area.

1. Observational Study: mapping in Humanitarian OpenStreetMap (HOT)

2. Experimental Study: geolocation in GroundTruth

Expected Results

- Distance-based localness affects success: the closer someone is, physically, the more likely they are to succeed at geolocation and mapping.
- Density-based localness affects success: In both mapping and geolocation, people from areas of similar density tend to be more successful.
- By taking localness into consideration, crowd-based geographic systems can greatly increase success factors.

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