Keeping Map Data Current Through the Use of Volunteered Geographic Information

James McAndrew
Colorado State University
National Park Service

Advancing GIScience with Open Source Technologies
Workshop by the ICA Commission on Open Source Geospatial Technologies
AutoCarto 2016 • Albuquerque, New Mexico • September 14, 2016

Background

- University of Denver
  - Capstone: Merging Volunteered Geographic Information Systems
- United States Geological Survey
  - The National Map Corps
- National Park Service
  - Places Project

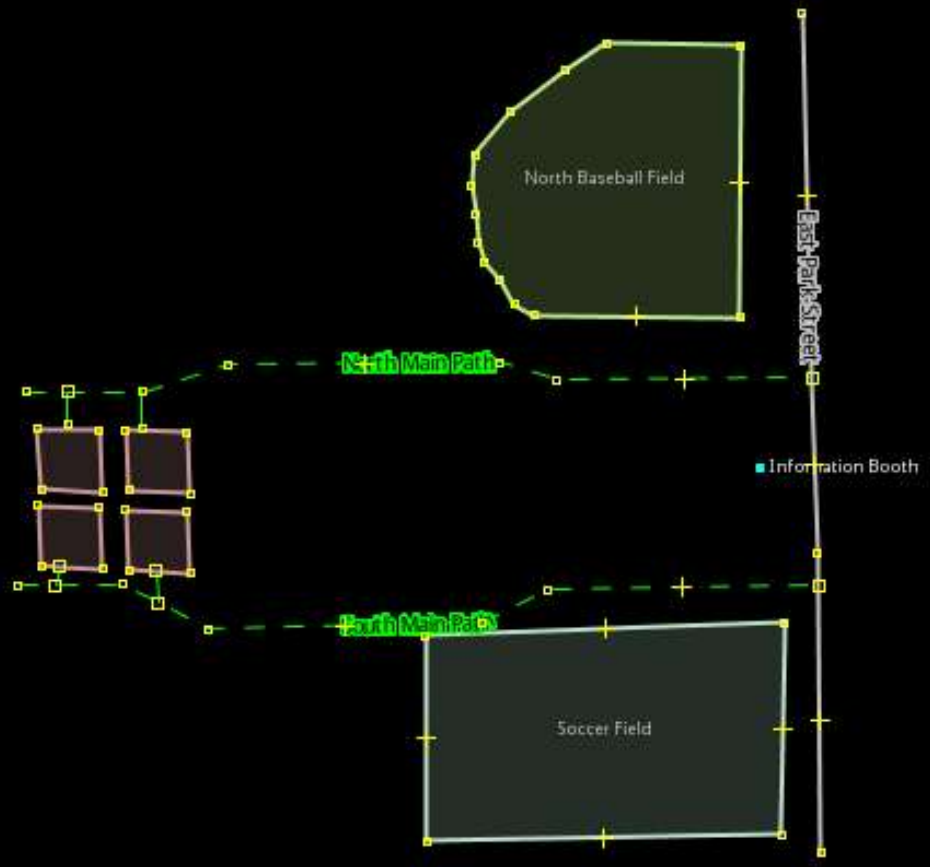
Rio Rancho Community Park Example

- Rio Rancho Community Park has assembled a team of professionals to map its:
  - Roads
  - Trails
  - Points of Interest
- They will use GPS, satellite imagery, and Unmanned Aerial Vehicles (UAVs) to create the best map
- Their timeline is 1 - 2 months

Colorado State University

Rio Rancho Community Park Mapped

- After 2 months the park map is complete



Colorado State University

The Park Continues to Grow

- A few years go by, and many modifications are made to the park.
  - New walkways are created
  - A new gazebo has been installed
  - New buildings have been added
  - New sports fields have been added

Visitors Look for Better Data

- Park visitors are having trouble using the official map of the park
- They begin to rely on data from external sources

Colorado State University

There Can Be Problems with External Data Sources

- The external sources include incomplete information
  - One of the sources includes a walking path that is officially closed for environmental reasons
  - The path is shown on the map, but it does not include the information about whether or not the path is open to the public
  - People relying on these external maps unknowingly walk along the closed path which may lead to environmental damage

Colorado State University

The Park Needs a Solution

- Volunteered Geographic Information (VGI)
  - The park managers have heard about crowdsourcing and volunteered geographic information
  - They are interested in learning if it can work for them

What is Volunteered Geographic Information?

- Volunteered Geographic Information (VGI) can be defined as any user-generated content with a spatial component
  - The volunteers are private citizens with few formal qualifications in geography, and their contributions are of variable quality (Goodchild 2007)
- VGI has emerged out of the more general concept user-generated content often termed as Web 2.0 (Crampton 2009)

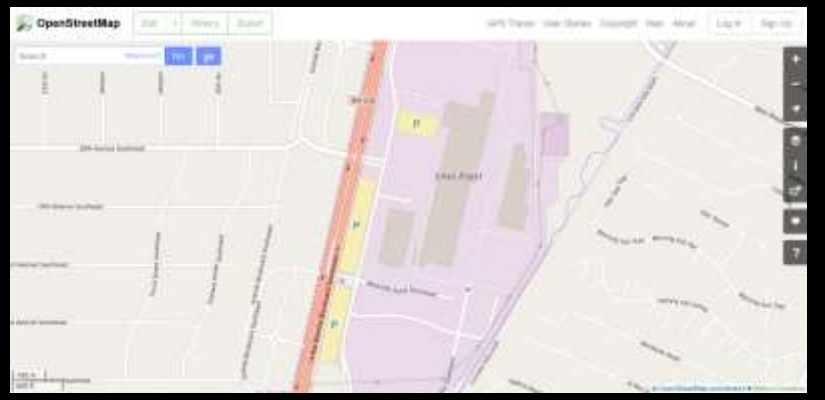
Colorado State University

VGI versus Crowdsourcing

- VGI can be described as a form of crowdsourcing where at least one component of the contributed information is geographic information
- The term crowdsourcing has been used to describe the concept of gathering information from untrained volunteers
- Penn State University's class, Open Web Mapping, has a good discussion on the differences (VGI and Crowdsourced Data Collection 2016)

Volunteered Geographic Information Examples

- OpenStreetMap
- USGS National Map Corps
- NPS Places Project
- WikiMapia
- Google Map Maker



Colorado State University

OpenStreetMap

- "Wikipedia of Maps"
- Started by Steve Coast at University College London in 2005
- Uses an open license (Open Database License)
- Uses completely free (unlicensed) software
  - Anyone can use and extend the code, architecture, and ideas

Colorado State University

OpenStreetMap Tools

- Mapnik
  - Mapbox Studio
  - TileMill
- Osmosis
- JOSM
- iD Editor
- OSM AND
- PostgreSQL / PostGIS data formats

USGS National Map Corps

- The United States Geological Survey (USGS) is currently using a process that allows volunteers to collect USGS structures data
- Similar to OpenStreetMap
  - Originally built on the same platform
  - Currently using a custom platform based on ESRI tools
- Only allows users to modify point datatypes

(United States Geological Survey 2016)

National Park Service Places

- An internal data collection portal for the National Park Service
  - Points of Interest
  - Trails
  - Roads
  - Buildings
  - Parking Lots
- Built on the OpenStreetMap data model
- Uses the default OpenStreetMap web based editor

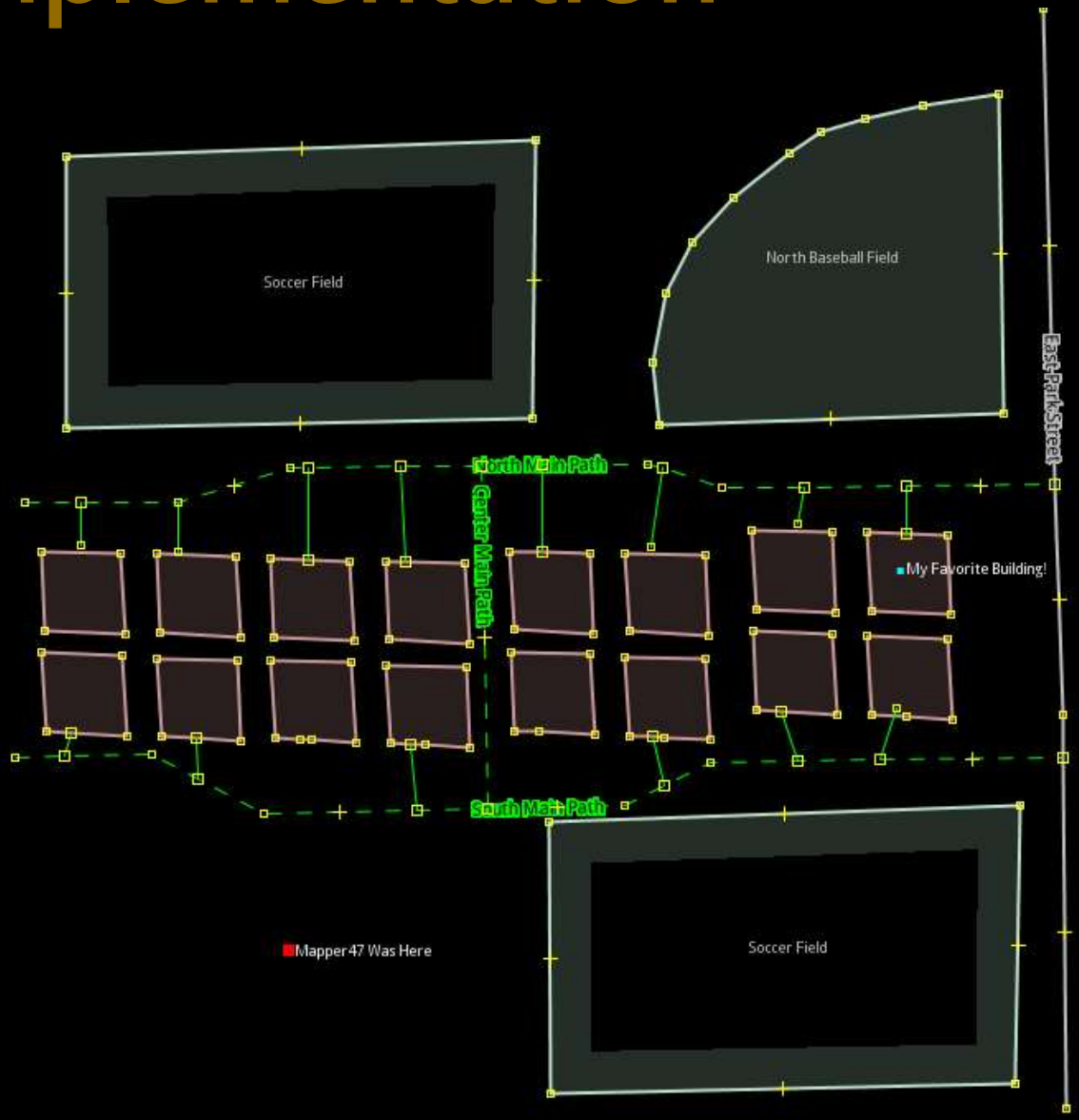
(National Park Service 2016)

VGI Implementation

- Rio Rancho Community Park uses the VGI model to:
  - Set up a system allowing the public to make edits to the map
    - Uses OpenStreetMap backend
    - Uses the OpenStreetMap web based editor
  - Users in the community make their contributions
  - The new map looks up-to-date

Colorado State University

VGI Implementation



Colorado State University

Using the Contributions

- Rio Rancho Community Park still has its original, professionally surveyed, dataset
- Some of the contributions are problematic:
  - Incorrect, or need more information
    - Ex. Trail Closure information
  - Not appropriate for the park map
    - Ex. “My Favorite Building”
  - Vandalism
    - Ex. “Mapper47 Was Here”

USGS National Map Corps: Data Validation Process

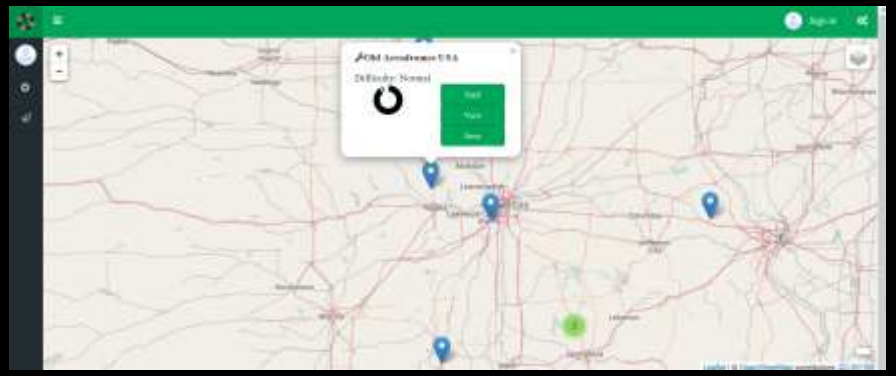
1. The contributions are made by a volunteer
2. The contributions are verified by other volunteers who have a certain amount of contributions to the map
3. The USGS runs a final quality check on the contributions before approving it for inclusion in the National Structures Dataset

(Poore et al 2013)

Microtasking

- Breaks a large task into many smaller tasks
- Allows the workload to be distributed to many individuals in small incremental changes

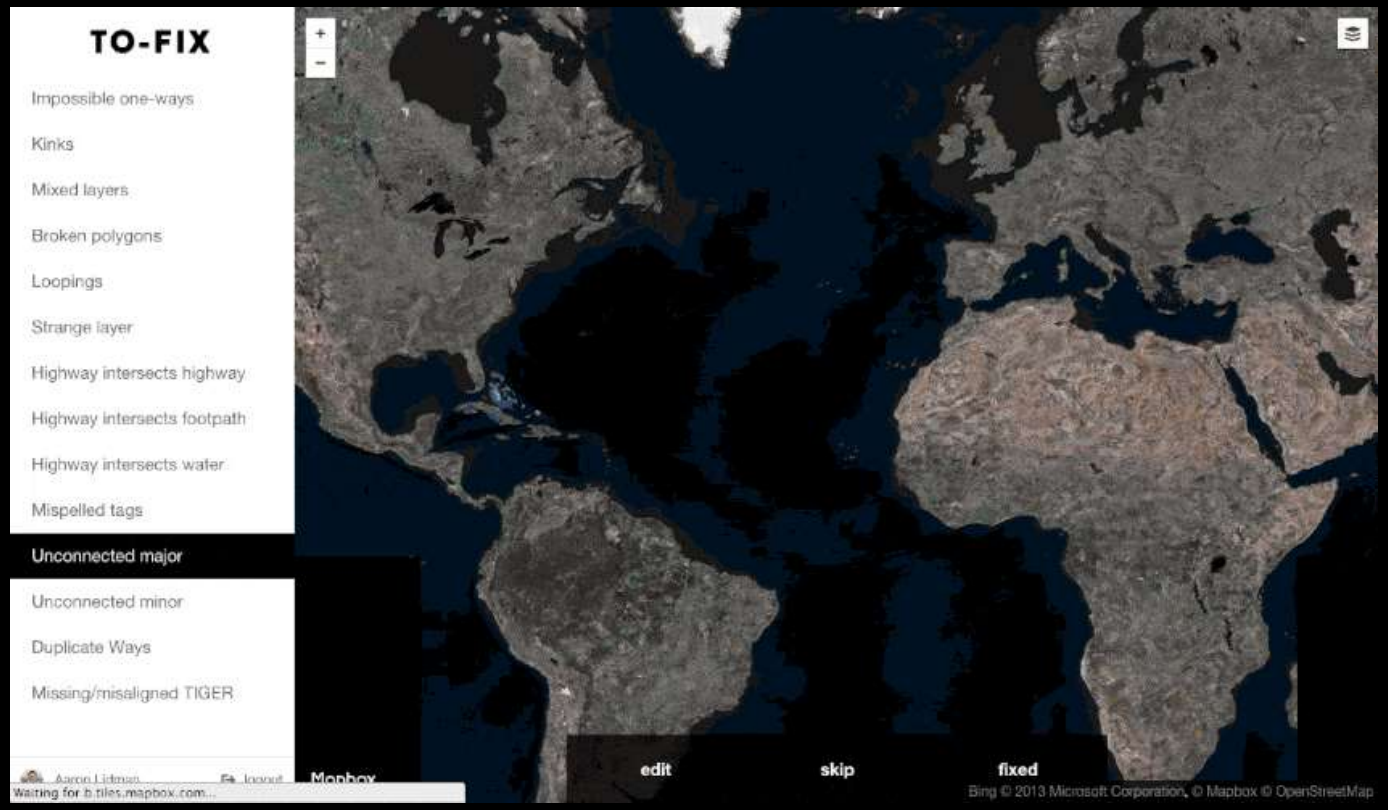
MapRoulette



- A simple web-based interface
- Allows users to fix advanced data integrity issues, such as topology errors
- Has been proved to be effective, with over 70,000 errors corrected in a span of less than three months (van Exel 2014)

Colorado State University

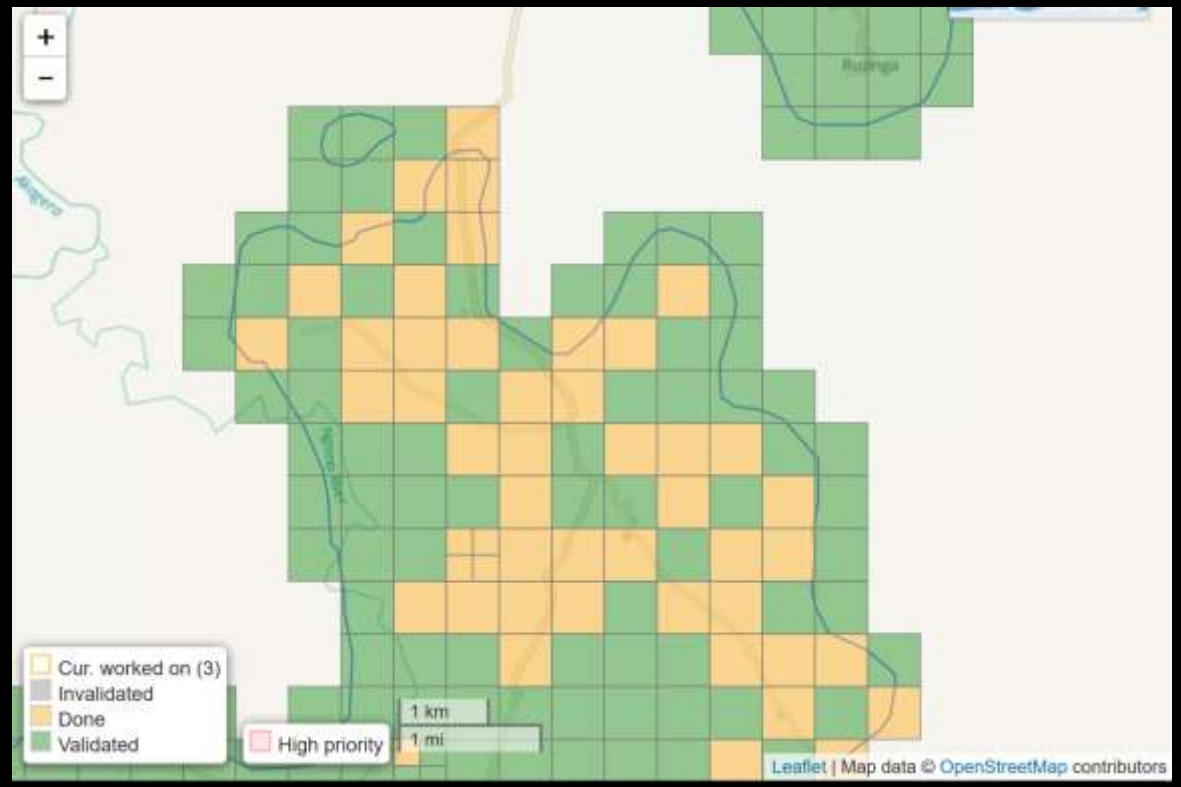
Mapbox To-Fix



(Lidman 2016)

Colorado State University

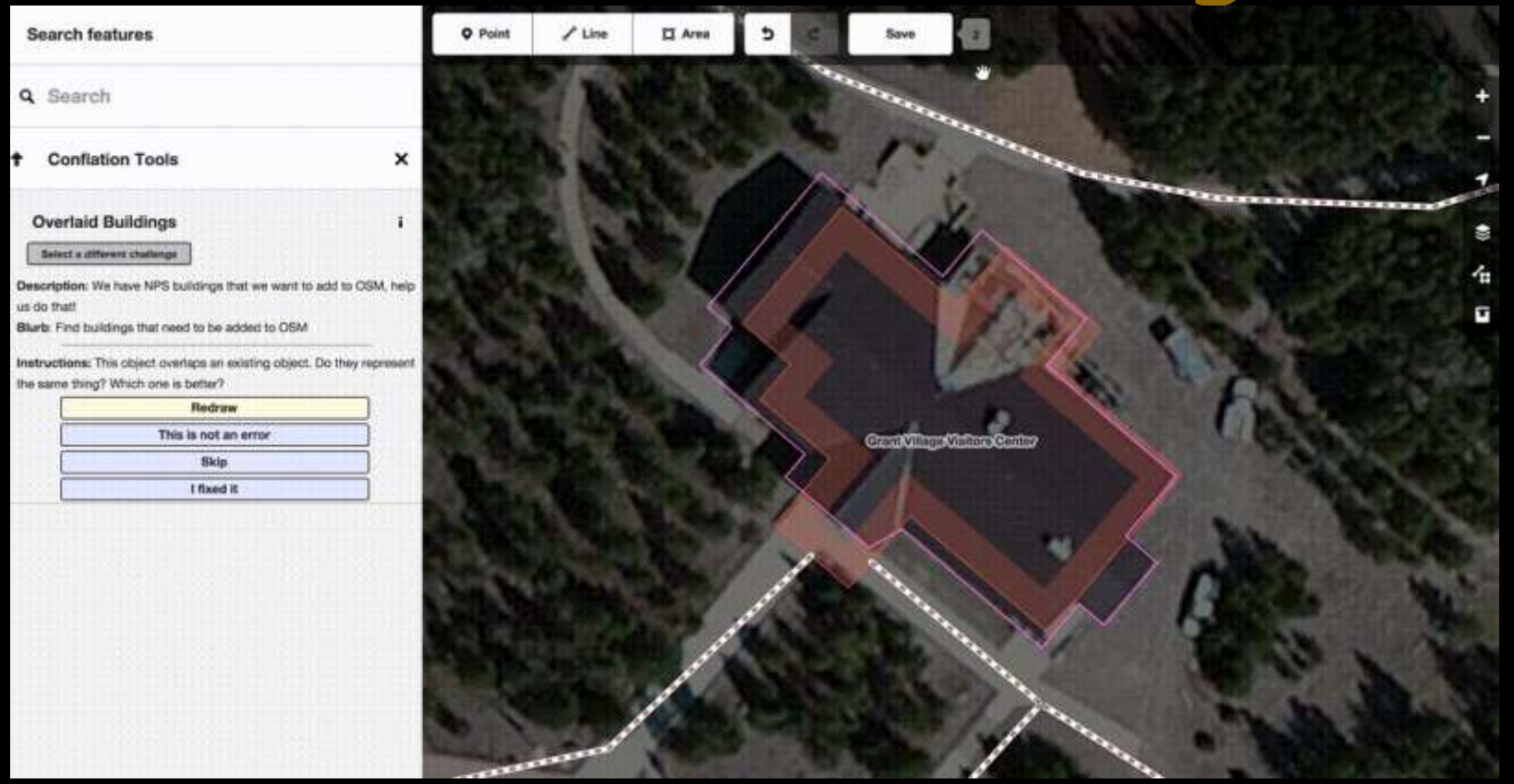
Humanitarian OpenStreetMap Team: Tasking Manager



(HOT Tasking Manager 2016)

Colorado State University

MapRoulette Web Editor Integration



(McAndrew 2015)

Colorado State University

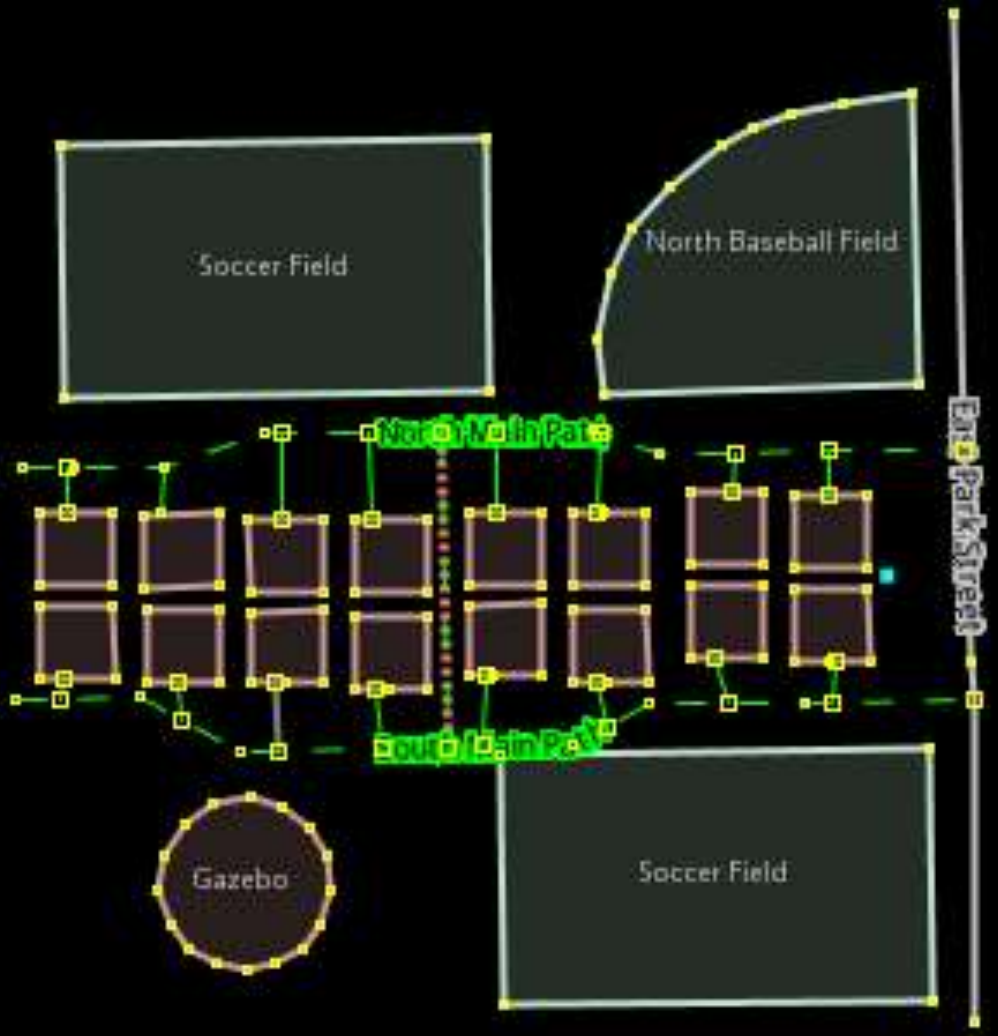
Expanding on Microtasking Conflation Tools

- Machine learning and statistics
  - What are users editing?
  - Are certain types of edits more prone to errors?
    - What information is typically missing from different datatypes
    - Are some locations more error prone than others?
  - This could allow microtasking tools to highlight areas that may be prone to error

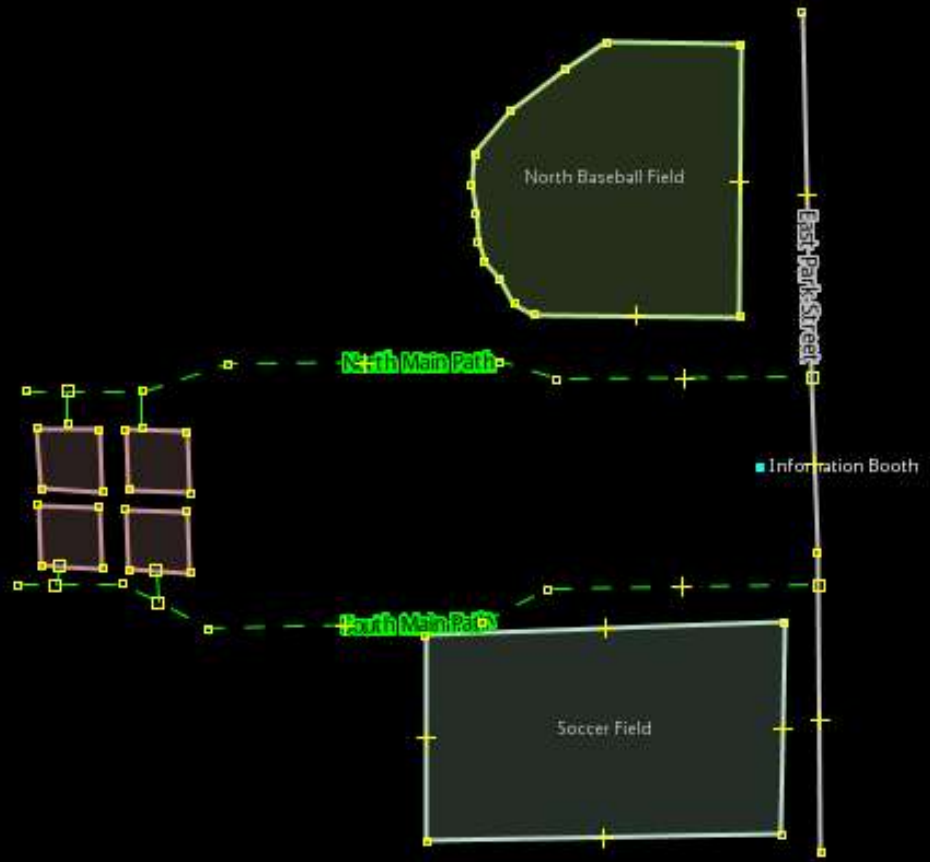
Rio Rancho Community Park

- Uses USGS Validation Model and a microtasking approach

Rio Rancho Community Park

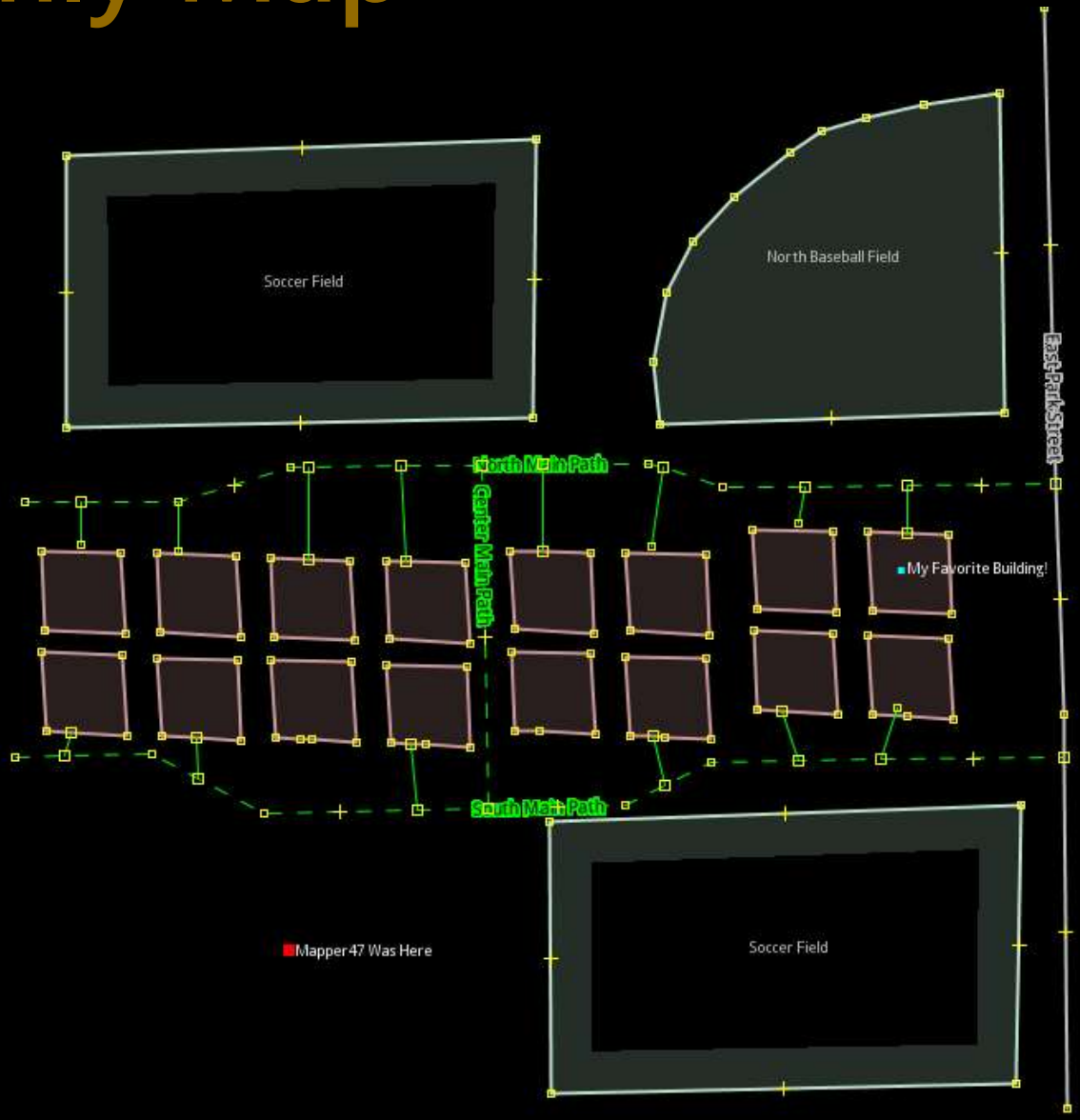


First Rio Rancho Community Park Map



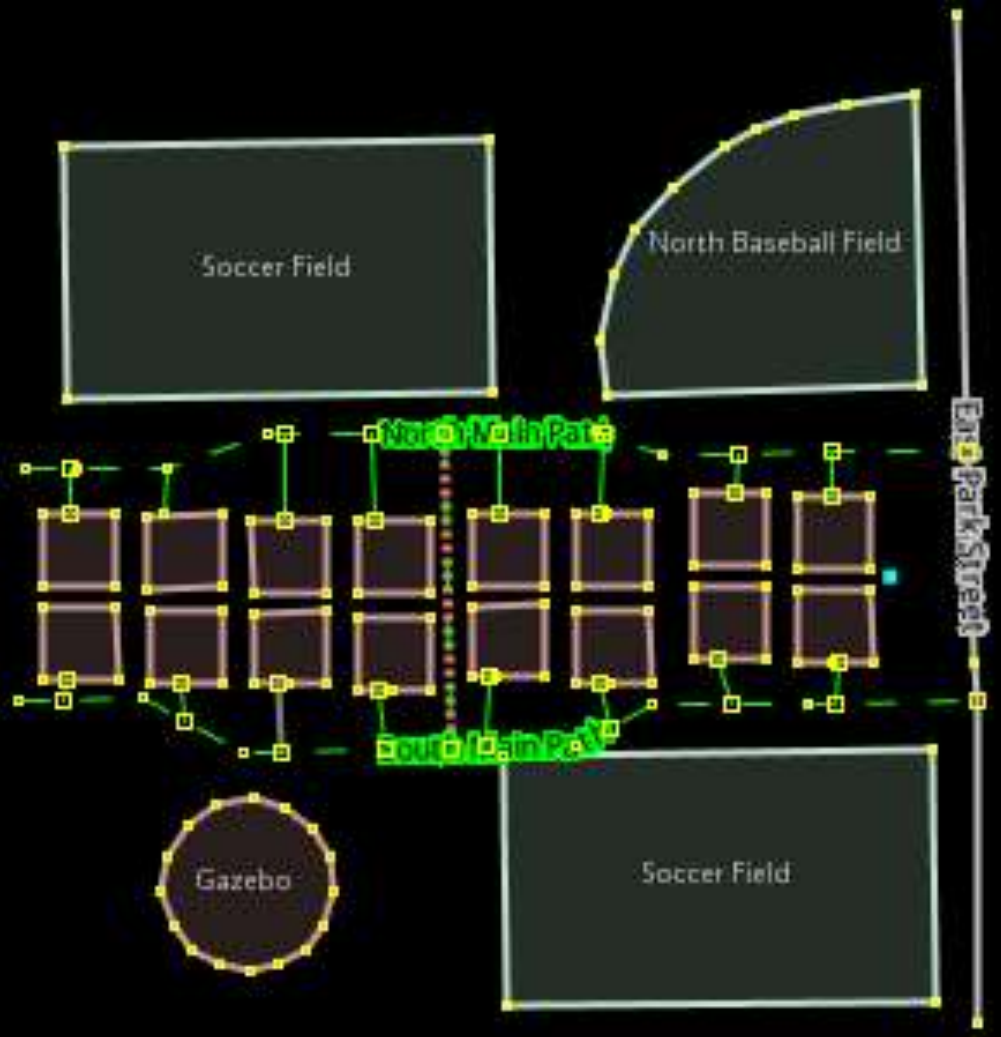
Colorado State University

VGI Only Map



Colorado State University

Rio Rancho Community Park



Colorado State University

Understanding the Contributors

- What do people expect to get out of the map and their contributions
  - Why are people contributing to the map?
  - Do people want to have access to their contributions in the future?
  - Do people want access to the compiled dataset?
  - How quickly can a user get back the information they contributed?

Keeping Data Current Across Platforms

- Using the same microtasking tools to push contributions
  - OpenStreetMap
  - USGS National Map Corps

Colorado State University

Future Research

- Learning from user contributions
  - Machine learning
  - Statistics

Dimensions to Open

- Source software
- Data
- Standards
- Access to research
- Education Resources

References

Crampton, J. W. "Cartography: Maps 2.0." Progress in Human Geography 33, no. 1 (2009): 91-100. doi:10.1177/0309132508094074.

Goodchild, Michael F. "Citizens as Sensors: The World of Volunteered Geography." GeoJournal 69, no. 4 (2007): 211-21. doi:10.1007/s10708-007-9111-y.

"HOT Tasking Manager - #2143" HOT OSM. Accessed September 12, 2016. http://tasks.hotosm.org/project/2143

Irwin, Nathaniel. "Places | National Park Service." National Parks Service. Accessed September 12, 2016. https://www.nps.gov/maps/tools/places/.

Lidman, Aaron. "To-fix: Improving OpenStreetMap through Micro Tasking." Mapbox. Accessed September 12, 2016. https://www.mapbox.com/blog/introducing-to-fix/.

McAndrew, James. "Less Bots, More Humans Using MapRoulette to Import Data." YouTube. 2015. Accessed September 12, 2016. https://www.youtube.com/watch?v=3rQ83mqj4bg.

"The National Map Corps." TNMCorps. Accessed September 12, 2016. http://navigator.er.usgs.gov/.

"OpenStreetMap." OpenStreetMap. Accessed September 12, 2016. http://www.openstreetmap.org/.

Poore, Barbara, Eric B. Wolf, Erin M. Korris, Jennifer L. Walter, and Greg D. Matthews. Structures data collection for The National Map using volunteered geographic information. Reston, Va.: U.S. Dept. of the Interior, U.S. Geological Survey, 2012.

"VGI and Crowdsourced Data Collection." VGI and Crowdsourced Data Collection. Accessed September 12, 2016. https://www.e-education.psu.edu/geog585/node/737.

"Wikimapia - Let's Describe the Whole World!" Wikimapia - Let's Describe the Whole World! Accessed September 12, 2016. http://wikimapia.org/.

Colorado State University

James McAndrew
James.McAndrew@colostate.edu
http://nps.gov/npmap