Facilitated-VGI, Smartphones and Geodesign: Building a Coalition while Mapping Community Infrastructure

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Abstract

The typical steps required to create a community-based Safe Routes to School (SRTS) or walkable community program include creating a local coalition; obtaining maps; collecting information about where children live, the routes they take to school and the condition of the streets along the way; and identifying existing walking and bicycling barriers. For many communities, creating the local coalition and collecting the data can be difficult tasks. However, through the combination of facilitated Volunteered Geographic Information and Geodesign processes that utilize mobile spatial technology it is possible collect the necessary planning data while generating interest in the project and further developing an excited and engaged local coalition.

1 Introduction

Citizens in small rural communities in the United States face numerous challenges when developing plans to make their communities more walkable. While many of these challenges are financial or policy related, there are cases where *Digital Methods in Geo-design* can be implemented to help a community move forward. One of these is obtaining an accurate picture of the existing pedestrian and biking systems, which is needed to analyze factors affecting the use, connectivity, condition, adjacency and accessibility of the transportation network. Often smaller communities don't have detailed georeferenced information of the non-motorist infrastructure or what they do have is incomplete. In either case it is necessary to develop this dataset before significant community planning efforts can be initiated (ELWOOD & LEITNER 1998). Unfortunately, the cost of hiring outside technical assistance to survey the network often exceeds the capacity of these communities, particularly those with fewer than 5,000 residents.

This paper presents how geospatial and mobile technology, along with crowdsourcing techniques such as volunteered geographic information (VGI), has been adapted and used to assess the infrastructure supporting non-motorized transportation in more than 30 Iowa communities. In addition to the collection and visualization of the data, this technique

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serves as a mechanism to further develop participant interest in joining a community coalition and provides the data necessary to facilitate discussions within that group.

2 Iowans Walking Assessment Logistics Kit

Following successful pilot projects at local schools, in 2009 the Iowa Department of Public Health partnered with Iowa State University Extension Landscape Architecture to create a new program called the Iowans Walking Assessment Logistics Kit (I-WALK). The I-WALK program is designed to help communities develop a sustainable model for community coalitions to update and evaluate safe routes to school information critical for ongoing planning and program delivery. I-WALK employs three participation techniques, including transportation tallies, web-based geospatially-enabled surveys, and smartphone mapping of the transportation infrastructure. The I-WALK program was expanded in 2012 to include community assessments focused on the needs of older residents.

Community-based participatory research (CBPR) techniques have been a cornerstone of the I-WALK program and are an important step toward motivating residents to participate in the community coalitions by allowing them to share their knowledge about the local landscape and built environment (NIH 2014). Citizens' involvement does not stop with simply providing their local knowledge; it is extended through the positioning of Geodesign techniques that allow residents to assess the current built environment and begin to ask how it might be altered. As valuable as it is for the participants to view and interact with visualizations of the infrastructure data, this step is not possible without first acquiring or collecting the data. This is accomplished through a form of community-based participatory research and focused crowdsourcing referred to by the authors as facilitated Volunteered Geographic Information (f-VGI).

2.1 Facilitated Volunteered Geographic Information

Originally coined by Michael Goodchild in 2007, VGI refers to user-generated geospatial data that are created by private citizens, without specialized training or expertise (GOODCHILD 2007). Through the use of VGI tools, participants around the globe are able to gather, visualize, produce, and share information on an unprecedented scale – thereby altering the world of digital spatial data (ELWOOD 2008; SUI 2011). OpenStreetMap (OSM), one of the most utilized and popular VGI-platforms creates "a freely available geographic database" that includes both transportation networks and points of interest (NEIS & ZIELSTRA 2014). While VGI offers substantial advantages such as timely and detailed data collection, the technology is not without limitations (GOODCHILD & LI 2012). More specifically, VGI carries no assurance of quality; participants collect data without central coordination and strict data collection protocols (HAKLAY et al. 2010). Quality assurance increases when VGI is facilitated through digital mapping interfaces – f-VGI allows the facilitator to establish the parameters of the project and limit participation to the local level (SEEGER 2008). F-VGI affords the researcher greater control of the data collection process and offers valuable insights into the range of public perceptions regarding local planning and design needs.

2.2 Geodesign

In a *Framework for Geodesign*, Carl Steinitz presents an iterative framework for Geodesign and argues "data collection is not the first step" (STEINITZ, 2012). However, in projects such as I-WALK in which a state agency and a university are bringing awareness of a design issue to the broader community and working to build a local coalition, data collection can be a great interactive first step that can precede a broader Geodesign project. As residents examine their community and collect the data, they experience and witness the limitations of the non-motorized transportation network and begin to ask questions about how it could be modified. This experience is important because it prepares the participants to engage in more thoughtful discussions that can be examined geospatially once the data have been collected. Participants in the data collection who would have otherwise not responded to a general request to join a "community walkability committee" are now more willing to participate in future discussions and take leadership roles in the development of the local coalition.

3 Infrastructure, Perceived Barriers and User Route Selection

F-VGI was used to collect several of the data sets necessary for the coalition and planners to visualize and identify improvements to implement. Two different participatory techniques were employed to collect these data: a web-based geospatial survey followed by infrastructure GPS-mapping workshops.

Fig. 1: Left: The most used routes to and from school appeared along streets south of the school while several intersections. Right: Particularly along Walnut Street northwest of the school were perceived by parents to have dangerous crossings.

3.1 Geospatial User Survey

A web-based solution was developed in the form of a geospatial survey that allows parents and their children to draw on an online map the routes they use or would consider using to walk or bike to school. Once entered, these routes are processed in a GIS model to create a weighted map identifying the routes. To protect individual privacy, routes identified by three or fewer respondent are not published to the map. In addition to routes, participants pin the locations of intersections they perceive as dangerous as well as other barriers that make it difficult to walk or bike (see Figure 1). Surveys developed for older adults ask respondents to identify the community locations to which they currently walk or bike and to draw the routes they walk or bike most frequently, as well as the locations to which they wish they could walk or bike.

3.2 Infrastructure GPS Mapping Workshops

Utilizing a f-VGI approach, community volunteers participate in a one-day mapping workshop that is facilitated by university and local public health program leaders. The facilitators provided orientation about the type of features volunteers would be mapping. For instance, during the pre-assessment training, participants review photo examples of broken and cracked sidewalks, intersection designs and other infrastructure items and learn how to score them. Volunteers may use their own smartphone or one of the twelve iPhones that are part of the I-WALK toolkit. Volunteers spend approximately 45 minutes learning to use and practicing with a customized mobile mapping application before being sent out into the community to map the infrastructure at the location(s) they have been assigned.

The application, built upon the Esri ArcGIS iOS framework, includes questions tailored to the type of environment the user is documenting (e.g., intersection or midblock). Each evaluated item is mapped using assisted visual map placement (AVMP) or the phone's GPS. Much like the processes employed in Photovoice workshops, volunteers also have the option of including photographs and comments as part of the evaluation (CATALINI & MINKLER 2009).

Participants evaluate the sidewalk at the middle of each block by first identifying the type of feature they are evaluating (sidewalk, intersection or other) and then responding to a series of questions. After completing the form, users identify the site on the map by either placing a marker at their current location via the GPS or by simply tapping on the map (see Figure 2). This process is repeated at intersections using the same method and a similar set of questions. Additional features that impede pedestrian and cyclist movement such as cars blocking sidewalks, vegetation growing into the walkway or excessive truck traffic are also mapped using the GIS app.

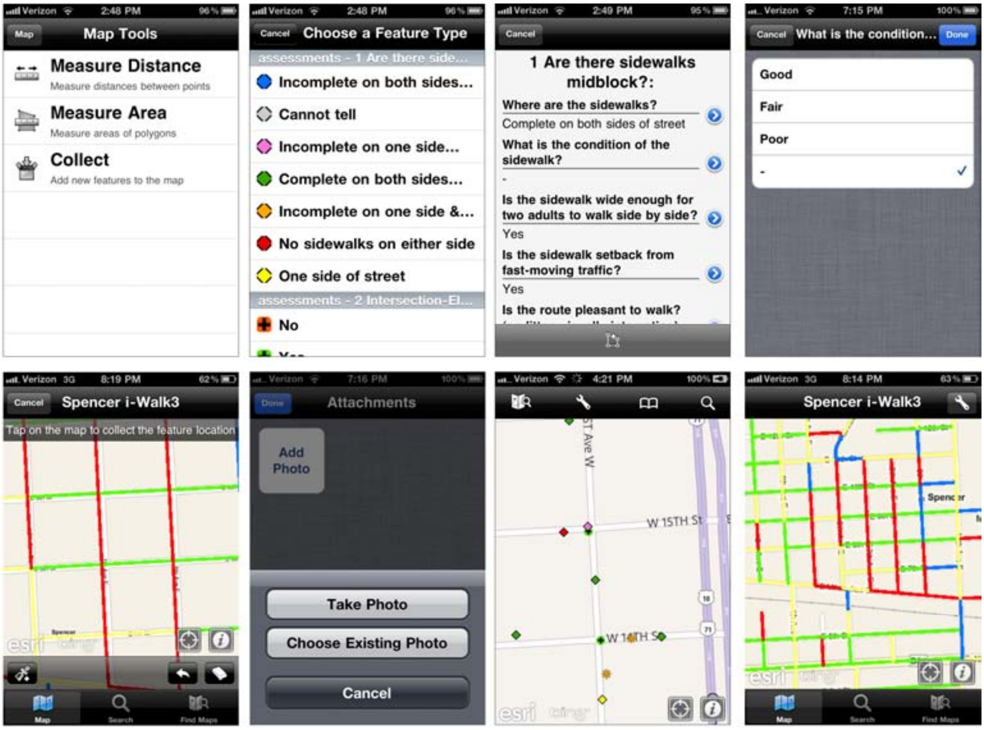

Fig. 2: A customized ArcGIS iOS app provides the means to collect and evaluate infrastructure on-site and to upload photographs of the features when necessary. Top left–right: 1) Select option to collect data, 2) Select the type of feature being evaluated, 3) Answer questions associated with the type of feature being evaluated, 4) Tap to record response, 5) Locate feature on map by tapping on location or via GPS, 6) Optionally take photo to append to feature record, 7) Display of feature points as they are collected by all participants, 8) Optional display of overlay data such as street layers or assigned study area boundary.

To minimize duplication or missing assessments locations, data was automatically displayed to all devices as it was collected. Optionally, participants could turn on a data layer showing their assigned collection area. Data collection was significantly faster using the f-VGI processes and the data collected were of higher quality than if volunteers had collected the data without facilitation. It should be noted that in most, if not all communities, the data would not have been collected if it were not for the facilitation component, even though residents owned or had access to the technical equipment necessary to collect the information.

As volunteers collected data, the information is sent to the GIS server and then shared back to the other devices. The sharing of information allows users in the field to quickly see which areas have already been evaluated and in which areas the data collection is taking more time (see Figure 3). Sharing of the data also allowed workshop participants that were not able to go into the field (school and city administrators) to stop by the workshop and view a near real-time map that could be queried to reveal patterns appearing in the infrastructure assessment. While the ability to share this data in this manner was not a requirement, it served as a valuable method that allowed the engagement of administrators that otherwise may have only provided token participation.

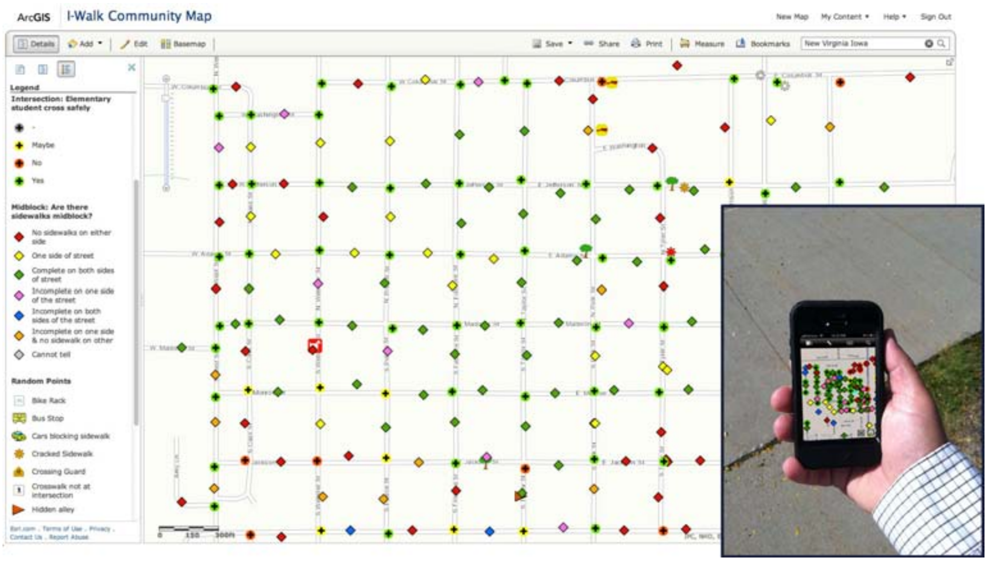

Fig. 3: During the data collection workshop the display of collected data on a device and on ArcGIS.com identifies where data still needed to be collected and the status of the infrastructure at the collected location. Following the workshop, this information is overlaid and analyzed with traffic accident data, locations identified in the geospatial user survey as perceived risks, and other mapped data.

4 Results

Upon completion of the workshop, the data are made available to the general public and used in analysis. Web mapping interfaces have been designed to allow coalition members to explore, query and overlay the collected data (see figure 4). A system developed to manage the collected survey and infrastructure data also allows school administrators to generate reports as needed and to add additional data over time.

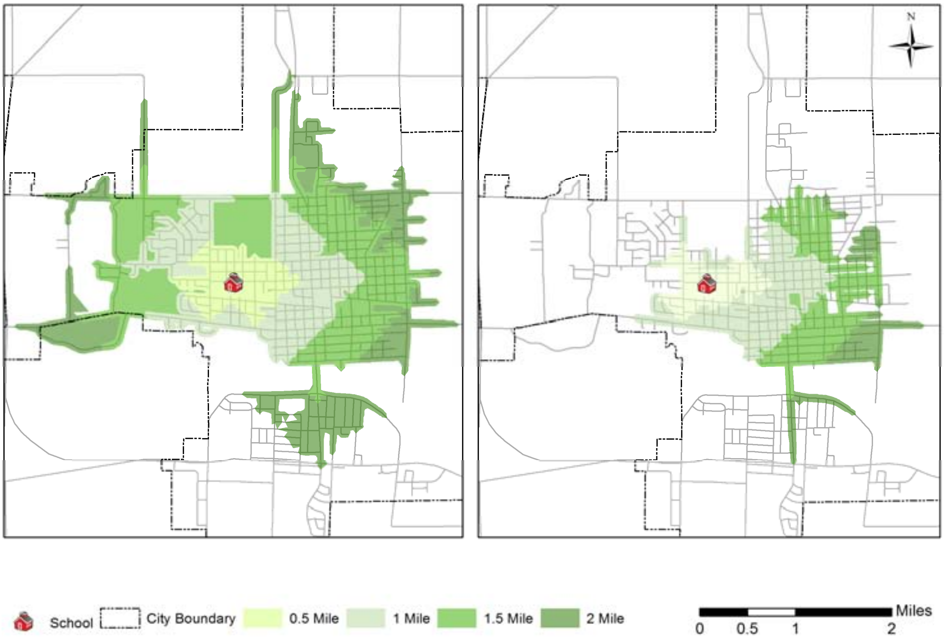

Fig. 4: Comparison of maps showing distance from school students could walk if sidewalks were available along at least one side of all streets versus where they can walk using the existing infrastructure.

4.1 Community Reach

More than 450 community members and students have participated in the GPS walkability assessments in 31 communities since the I-WALK program was established in 2009. More than 7,000 midblocks, 4,500 intersections, and 2,200 additional features have been evaluated and mapped during the GPS walkability assessments while more than 2,400 features have been mapped through the web survey. The use of f-VGI and smartphone data collections has been successful at both public and private schools in both urban and rural settings as well as with programs focused on community walkability for older residents.

Pre- and post-surveys of volunteers found that a majority of participants were not aware and were surprised at how extreme the issues impacting walkability were in their community.

4.2 Data Validation

Post-data validation using remote sensing indicates an initial field accuracy rate of approximately 85%. While this rate may seem low, it accounts for errors in which no sidewalk data was collected (3%), misidentification of sidewalk on one, both or partial sides of the street (3%), and incomplete responses (10%) in which null values were provided for some of the collected data point attributes. Improvements made to the interface collection form have decreased the number of incomplete responses; however, the implementation of data response branching would likely improve this further.

5 Conclusion and Next Steps

The use of f-VGI and the implementation of preliminary Geodesign processes have been moderately successful and have saved communities several thousands of dollars in data acquisition costs. However, several improvements could be made to these methods. The first is the development of response branching within the data form collection so that when a participant responds that there are no sidewalks, the remaining questions regarding the sidewalk are removed from the form. Currently there are technologies that provide this capability and the I-WALK team is evaluating how they can be incorporated into the current process.

The second issue is that evaluation of sidewalks is limited to midblocks points. This limitation makes it difficult to generate networks for use in what-if analysis scenarios. Integration with OpenStreetMap and other network systems is being investigated. However, there are current limitations in how these tools record the sidewalk and crosswalk attributes as part of the street geometry. Thus, the author is currently in the process of developing a new f-VGI process that utilizes representative networks that can be more easily visualized and modeled to better document and interact with features in the built environment.

While technology has played a significant role in the success of the project by allowing users to generate data in a fun and useful manner, it is the participatory nature of how the technology is utilized that provides the impetus for project ownership and team building. Without the local coalitions that are built through the use of these technologies, many of these community projects would simply end as data points on a map.

References

CATALANI, C. & MINKLER, M. (2010), Photovoice: A Review of the Literature in Health and Public Health. Health Education Behavior, 37 (424).

ELWOOD, S. & LEITNER, H. (1998), GIS and Community-based Planning: Exploring the Diversity of Neighborhood Perspectives and Needs. Cartography and Geographic Information Systems, 25 (2), 77-88.

ELWOOD, S. (2008), Volunteered geographic information: key questions, concepts and methods to guide emerging research and practice. GeoJournal, 72 (3), 133-135.

GOODCHILD, M. F. (2007), Citizens as sensors: the world of volunteered geography. GeoJournal, 69 (4), 211-221.

GOODCHILD, M. F. & LI, L. (2012), Assuring the quality of volunteered geographic information. Spatial Statistics, 1, 110-120.

HAKLAY, M. M., BASIOUKA, S., ANTONIOU, V. & ATHER, A. (2010), How many volunteers does it take to map an area well? The validity of Linus' law to volunteered geographic information. The Cartographic Journal, 47 (4), 315-322.

NATIONAL INSTITUTE OF HEALTH (NIH) (2014), Community-Based Participatory Research. http://obssr.od.nih.gov/scientific_areas/methodology/community_based_participatory_research/ (last access February 20, 2014).

NEIS, P. & ZIELSTRA, D. (2014), Recent Developments and Future Trends in Volunteered Geographic Information Research: The Case of OpenStreetMap. Future Internet, 6, 76-106.

SEEGER, C. J. (2008), The role of facilitated volunteered geographic information in the landscape planning and site design process. GeoJournal, 72 (3-4), 199-213

STEINITZ, C. (2012), A Framework for Geodesign – Changing Geography by Design. Esri, Redlands, CA.

SUI, D. Z. (2011), Introduction: Strategic directions for the geographical sciences in the next decade. The Professional Geographer, 63 (3), 305-309.