ARTICLE

Quality Assessment and Accessibility Mapping in an Image-Based Geocrowdsourcing Testbed

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ABSTRACT

Geocrowdsourcing is a significant new focus area in mapping for people with disabilities. It utilizes public data contributions that are difficult to capture with traditional mapping workflows. Along with the benefits of geocrowdsourcing are critical drawbacks, including reliability and accuracy. A geocrowdsourcing testbed has been designed to explore the dynamics of geocrowdsourcing and quality assessment and produce temporally relevant navigation obstacle data. These reports are then used for route planning, obstacle avoidance, and spatial awareness. Recently, the geocrowdsourcing testbed has been modified to focus on the contribution of images and short descriptions, rather than the more lengthy previous reporting process. The quality assessment workflow of the geocrowdsourcing testbed is contrasted with a modified quality assessment workflow, implemented in the simpler and quicker image-based reporting paradigm. General quality assessment of data position and temporal characteristics is still possible, while general data attributes and detail are now supplied by a moderator from the contributed image. The derivation of obstacle location from multiple intersected image direction vectors does not produce reliable results, but an approach using buffered convex hulls works dependably. This simpler, quicker geocrowdsourcing workflow produces geocrowdsourced obstacle data and quality assessment estimates for location, time, and attribute accuracy.

Keywords: geocrowdsourcing, quality assessment, accessibility, vision impairment, disability

RÉSUMÉ

La production participative d'informations géographiques (*geocrowdsourcing*) est un nouveau sujet d'intérêt dans le domaine de la cartographie à l'intention des personnes atteintes de handicaps. Elle fait appel aux apports de données publiques à la saisie desquelles les méthodes de travail classiques en cartographie sont mal adaptées. Si la production participative d'informations géographiques offre des avantages, elle présente toutefois aussi d'importants inconvénients,

Cartographica 53:1, 2018, pp. 1–14 © University of Toronto Press doi:10.3138/cart.53.1.2017-0013

liés notamment à la fiabilité et à l'exactitude. La production participative d'informations géographiques est soumise à un banc d'essai destiné à l'étude de sa dynamique et de ses processus d'évaluation de la qualité, ainsi qu'à la production de données pertinentes sur le plan temporel relatives aux obstacles à la navigation. Les résultats sont ensuite utilisés dans la planification d'itinéraires, l'évitement d'obstacles et la relation spatiale. Le banc d'essai en question a récemment été modifié de manière à cibler les apports d'images et de brèves descriptions, plutôt que les apports résultant du processus précédent plus long de production de l'information. Le processus d'évaluation de la qualité du banc d'essai est comparé à un processus d'évaluation de la qualité modifié, issu du paradigme d'information plus simple et plus rapide basé sur l'image. L'évaluation globale de la qualité du positionnement que permettent les données et de leurs caractéristiques temporelles demeure possible, alors que les attributs généraux et le détail des informations sont maintenant fournis par un modérateur à partir des apports d'images. La dérivation de la localisation des obstacles à partir d'images présentées selon divers axes vectoriels qui se croisent ne produit pas de résultats fiables, mais une méthode faisant appel à l'enveloppage convexe fonctionne de manière fiable. Cette méthode de production participative d'informations géographiques, plus simple et plus rapide, livre de l'information sur les obstacles et des estimations de la qualité des données quant à l'exactitude de la localisation, du moment et des attributs.

Mots clés : accessibilité, évaluation de la qualité, handicap visuel, invalidité, production participative d'informations géographiques

Introduction

The GMU Geocrowdsourcing Testbed (GMU-GcT) is a crowdsourcing system designed to facilitate the gathering, validation, quality assessment, and publication of transient obstacle data to assist persons with blindness, visual impairment, or mobility impairment. The data collected during the geocrowdsourcing process are used to help end users with route planning, obstacle avoidance, spatial awareness, and general information about changes in the local pedestrian network. A major challenge for this system, and for most geocrowdsourcing systems, is quality (Goodchild 2007). The quality assessment workflow embedded in the GMU-GcT is based on a social moderation process described by Goodchild and Li (2012) and has been discussed in numerous publications and technical reports, such as Qin and others (2015, 2016), and Rice and others (2014, 2016). This article presents a recent iteration in the development of the GMU-GcT, which involves a simplification of the geocrowdsourcing workflow to focus on the contribution of an image, from which the atomic elements of geographic information (location, time, attribute) can be extracted. We review the general motivations for this updated geocrowdsourcing testbed and the information that can be extracted from the contributions. We compare the quality assessment information that can be generated from a simple image-based system and from the original GMU-GcT.

The contribution of this article is threefold. First, we present the context for the geoaccessibility work that it describes. Second, we present a paradigm for geospatial collection from the public that is quick and easy, resembling the daily image-based social media platforms that require a simple picture and short description. Third, we present an example of geocrowdsourced data collection and the quality assessment information that can be generated from it and present this information in the context of previous geocrowdsourcing accuracy studies, such as Girres and Touya (2010).

The next section of this article introduces relevant research and motivations for this work from the domains of geoaccessibility and geocrowdsourcing. Further sections introduce the GMU Geocrowdsourcing Testbed (GMU-GcT), which was iteratively built to provide improved accessibility information and to study the dynamics of crowdsourcing, discusses quality assessment workflows in the GMU-GcT, and introduce an image-based geocrowdsourcing tool that greatly simplifies the process of geocrowdsourced report contribution and changes many of the quality assessment elements of the GMU-GcT to function from the limited contribution elements. The conclusion summarizes the value of the research work presented and suggests several future research directions.

Literature Review

Geoaccessibility research with origins in tactile mapping is presented as a relevant starting point for recent research in Web-based mapping and contemporary research in geocrowdsourcing for accessibility. Geotechnology has been a major innovative driver of this work, as has been the scientific study of data validation and quality assessment, all of which are reviewed here.

TACTILE MAPS, GIS, AND THE CONTEXT OF GEOACCESSIBLITY

Communicating spatial information to blind and visually impaired persons has been a significant challenge and area of research interest for cartographers, psychologists, geographers, and educators for many decades. Golledge (2001) suggests that spatial information, both in print and in digital form, is a key for helping blind, visually impaired, and mobility-impaired individuals participate fully in society. Long-standing interest in this topic is evidenced by over 100 papers on a wide number of topics produced by participants in the International Cartographic Association's Commission on Maps and Graphics for Blind and Partially Sighted Persons, including notable papers on tactile map production technologies (Perkins 2001), map publication (Taylor 2001; Przyszewska and Szyszkowska 2011), new technological approaches (Coulson, Riger, and Wheate 1991, Coulson 1991, Rice and others 2012a), and both theoretical and applied work on tactile symbolization (Tatham 1991, 2001, Eriksson 2001).

A notable early insight from Coulson (1991) is that geographic information systems will be an important tool for generalizing and simplifying complex representations for use in tactile mapping systems. Geotechnology has generally been a great help to ICA researchers, who have demonstrated the usefulness of technology for pushing the boundaries forward, including notable systems such as the Tactile Map Automated Production system (Miele and others 2006, Miele 2007) that generates tactile maps with a Braille embosser using TIGER street centerline files. Golledge and colleagues developed the UCSB Personal Guidance System over a period of 20 years and documented their findings in over 40 peer-reviewed journal articles, book chapters, and proceedings papers (Golledge and others 1998, 2005, 2007, Loomis and others 2001). This personal guidance system combines GPS, GIS, auditory cues, an electronic compass, and a tactile pointer to provide spatial information to a blind person travelling through an unfamiliar environment. Golledge's research collaborators Jacobson and Rice published cartographic research summarizing the results of experimental tactile and auditory map experiments (Rice and others 2005). Their goal was to develop map-based systems for helping blind individuals rapidly acquire spatial knowledge, which could then be both confirmed and augmented during field-based exploration using the UCSB Personal Guidance System. This article presents an extension of that system with respect to its major drawback, which is the ability of the system to be updated with real-time information about obstacles and hazards along pedestrian corridors. This extension uses a geocrowdsourcing testbed to generated transient obstacle reports.

GEOTECHNOLOGY AND INNOVATION

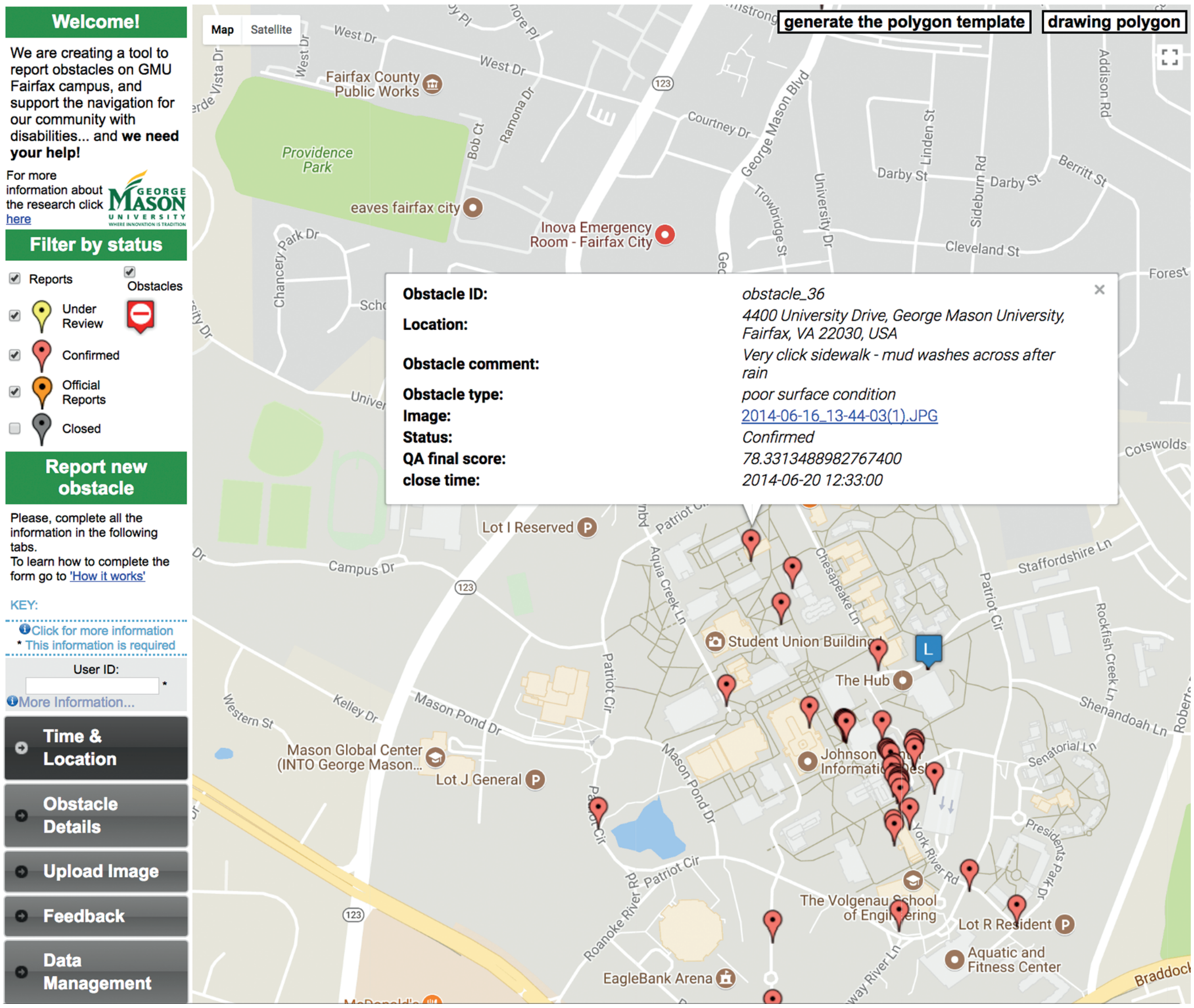
With regard to tactile mapping and technology-based systems such as the UCSB Personal Guidance System, Perkins (2002) provides a useful caution against adopting technological and engineering-based approaches that ignore end user feedback. He advocates user-centred, bottom-up, and socially aware approaches, rather than technocentric approaches that ignore wider social issues and views of impairment. Perkins suggests that "researchers should focus more on the social context of map use, and let that drive design decisions, instead of spending large research grants on often inappropriate technological solutions" (Perkins 2002, 526). Geotechnical innovation should be contextualized with social issues, user feedback, and the needs of end users.

Perhaps the most prominent recent geotechnical innovation in the cartographic and geographic information science disciplines is geocrowdsourcing, alternatively referred to as volunteered geographic information (Goodchild 2007, 2009). This innovation features the collection, curation, and use of geospatial data by members of the public, many of whom are untrained. The public collection and curation of cartographic data offers many benefits, such as local geographic expertise, continuous publishing and update cycles, responsiveness to disasters and other time-sensitive events, and the ability to create interoperable, reusable, and open sources of data. The major drawbacks of geocrowdsourcing are reliability and accuracy. Resolving these drawbacks, particularly for applications associated with blind, visually impaired, and mobility-impaired end-users, is critical and is a major focus for our work.

QUALITY ASSESSMENT AND GEOCROWDSOURCING

The accuracy of geocrowdsourced data has been a major area of research, given its strategic nature. Haklay (2010) and Girres and Touya (2010), represent two notable research efforts to characterize the uncertainty in geocrowdsourced data. Haklay (2010) asserts that the accuracy of positioning of features within OpenStreetMap data in the United Kingdom is variable, but averages about 6 m from the true position. Many subsequent studies of OpenStreetMap data have confirmed this general finding, with helpful summaries of this research in Rice (2015) and Ruitton-Allinieu (2011). Girres and Touya's analysis of OpenStreetMap data is comprehensive in its treatment of uncertainty and therefore an exemplar and model for our own quality assessment process. They look not only at positional accuracy of features in French OpenStreetMap data sets, but include other facets of geospatial uncertainty articulated by Hunter and Beard (1992), Guptill and Morrison (1995), and Veregin (1999), including attribute uncertainty, semantic accuracy, logical consistency, temporal consistency, completeness, and lineage. Jokar Arsanjani and others (2015) provide an excellent overview of research and applications using OpenStreetMap, including uncertainty and accuracy.

Goodchild and Li (2012) provide additional important context for our quality assessment work. They assert that there are three general methods for assessing geocrowdsourced data quality: (1) a social approach, (2) a crowdsourced approach, and (3) a geographic approach. The social approach includes intervention and assessment by trained moderators, who fix errors and provide ground truth for geocrowdsourced data. This social approach to quality assessment is used in many geocrowdsourcing applications, including the one described in this article. The second approach, where regular contributors and the public at large will find and correct errors, referred to as a crowdsourced approach, is based on Linus' Law and is demonstrated in Haklay and others (2010). This approach



Welcome!

We are creating a tool to report obstacles on GMU Fairfax campus, and support the navigation for our community with disabilities... and **we need your help!**

For more information about the research click here

Filter by status

Please, complete all the information in the following tabs.
To learn how to complete the form go to 'How it works'

Obstacle ID:	*obstacle_36*
Location:	*4400 University Drive, George Mason University, Fairfax, VA 22030, USA*
Obstacle comment:	*Very click sidewalk - mud washes across after rain*
Obstacle type:	*poor surface condition*
Image:	2014-06-16_13-44-03(1).JPG
Status:	*Confirmed*
QA final score:	*78.3313488982767400*
close time:	*2014-06-20 12:33:00*

Figure 1. The George Mason University Geocrowdsourcing Testbed (GMU-GcT)

works well for large and active user-generated content projects such as OpenStreetMap, but not as well for smaller projects with few contributors. Goodchild and Li (2012) describe the final method of quality assurance as the geographic approach, where user-contributed data are compared with known geographic phenomena, and inconsistencies occur when contributions conflict with known principles and rules. All three methods have benefits and drawbacks, depending on the type of geocrowdsourcing application being used and the needs of end users. The social approach is the method most appropriate for our work and has been implemented and presented in Qin and others (2016) and Rice and others (2014).

The GMU Geocrowdsourcing Testbed

With Coulson's cautionary advice in mind, and with awareness of the numerous research contributions from ICA participants and others, the authors of this article present the GMU Geocrowdsourcing Testbed (GMU-GcT; Figure 1), a crowdsourcing system designed to gather, validate, quality assess, and publish transient obstacle data to assist blind, visually impaired, and mobility-impaired individuals. These data are used to help end users with route planning, obstacle avoidance, spatial awareness, and general information about changes in the local pedestrian network. The system has been developed over a period of years and is documented in several research reports (Rice and others 2012b, 2013a, 2014), journal articles (Rice and others 2012a, 2013b, Aburizaiza and Rice 2016, Qin and others 2016), student theses (Paez 2014, Rice 2015), and conference papers (Rice and others 2011, Qin and others 2015).

This article extends previous work on quality assessment by implementing strategic changes in the GMU-GcT aimed at increasing the volume of transient obstacle reports and

Table 1. Required, optional, and derived contribution elements in the three versions of the GMU-GcT

	Desktop	Mobile	Image Share
User ID	Required	Required	Optional
Location (icon placement)	Required	Optional	
Location (GPS)	N/A	Automatic	Automatic
Location description	Optional	Optional	
Observation date/time	Required	Required	Automatic
Obstacle category	Required	Required	What?
Obstacle description	Required	Required	Where?
Obstacle duration	Required	Required	
Obstacle urgency	Required	Required	
Image	Optional	Optional	Required
Feedback	Optional	Optional	

determining the relevance of existing quality assessment metrics in the context of a much simpler and more streamlined geocrowdsourcing contribution tool. Specifically, crowdsourcing volunteers have suggested that the contribution process in the GMU-GcT needs fewer required contribution elements. The desktop version of the GMU-GcT (Table 1) has seven required contribution elements and three additional optional contribution elements. Initial efforts to streamline this contribution process and incorporate user feedback resulted in the production of a mobile version of the GMU-GcT. This version uses mobile device GPS to assist in report positioning. As seen in Table 1, the mobile version has nearly as many required contribution elements as the desktop version. End users continue to report difficulty positioning reports with the GPS-estimated position and a locator icon placed with a finger tap.

In recognition of many of these difficulties, a streamlined version of the GMU-GcT was designed around a single, fundamental reporting task: the contribution of an image showing an obstacle on a pedestrian walkway. The value of this image, according to moderator feedback, is higher than that of any other item provided by contributors. A simpler system built around this single task may encourage a greater volume of report submissions. Table 1 shows that the only required element in this "Image Share" version of the GMU-GcT is the contribution of an image.

The simplified Image Share tool asks a free-form question to contributors about where an obstacle is located, and what it is. A response to this "What? Where?" question provides additional information used by the moderator to refine position and obstacle attributes. The key to the functionality of this streamlined system is the extraction of position, orientation, and temporal data from EXIF metadata embedded in the contributed image, and the exploitation of these metadata to provide location information and use of the image to define obstacle attributes. The contribution process is similar to the many image-based social media tools, such as Instagram, where the image is the focus. A short text-based message provided with the required image can offer additional information for obstacle positioning and obstacle attributes.

Quality Assessment and the GMU-GcT

To provide confidence in the information contained in the GMU-GcT, researchers have designed a comprehensive quality assessment methodology based on Goodchild and Li's social moderation process (Goodchild and Li 2012). This process and its many elements are described in detail in Rice and others (2015), Aburizaiza and Rice (2016), and Qin and others (2016). A difficult element of the GMU-GcT contribution process highlighted in Paez (2014) and Qin and others (2015) is the selection of an obstacle category, which requires an understanding of the category definitions. The obstacle categories used by the GMU-GcT have been refined over time and currently include the following six obstacle categories: sidewalk obstruction, construction detour, entrance/exit problem, poor surface condition, crowd/event, and "other." These categories were developed through an extensive end user interview process and are not mutually exclusive (Rice and others 2013a, 2014, Paez 2014). To re-evaluate the difficulty associated with obstacle category selection reported in Qin and others (2015), 15 obstacle pictures were shown to 26 current crowdsourcing contributors, who selected an obstacle type, an estimated obstacle duration, and an obstacle urgency for each picture. This selection process was done after a preliminary training exercise, where obstacle types, durations, and urgencies were defined and illustrated with examples. Figure 2 shows consensus in the type/duration/urgency attributes for an obstacle, while Figure 3 shows conflicting views and differences in the basic obstacle attributes. Simply put, some obstacles are easy for geocrowdsourcing participants to define with consensus, while others are much more difficult.

The existing quality assessment workflow, discussed in detail in Rice and others (2014), Qin and others (2015,

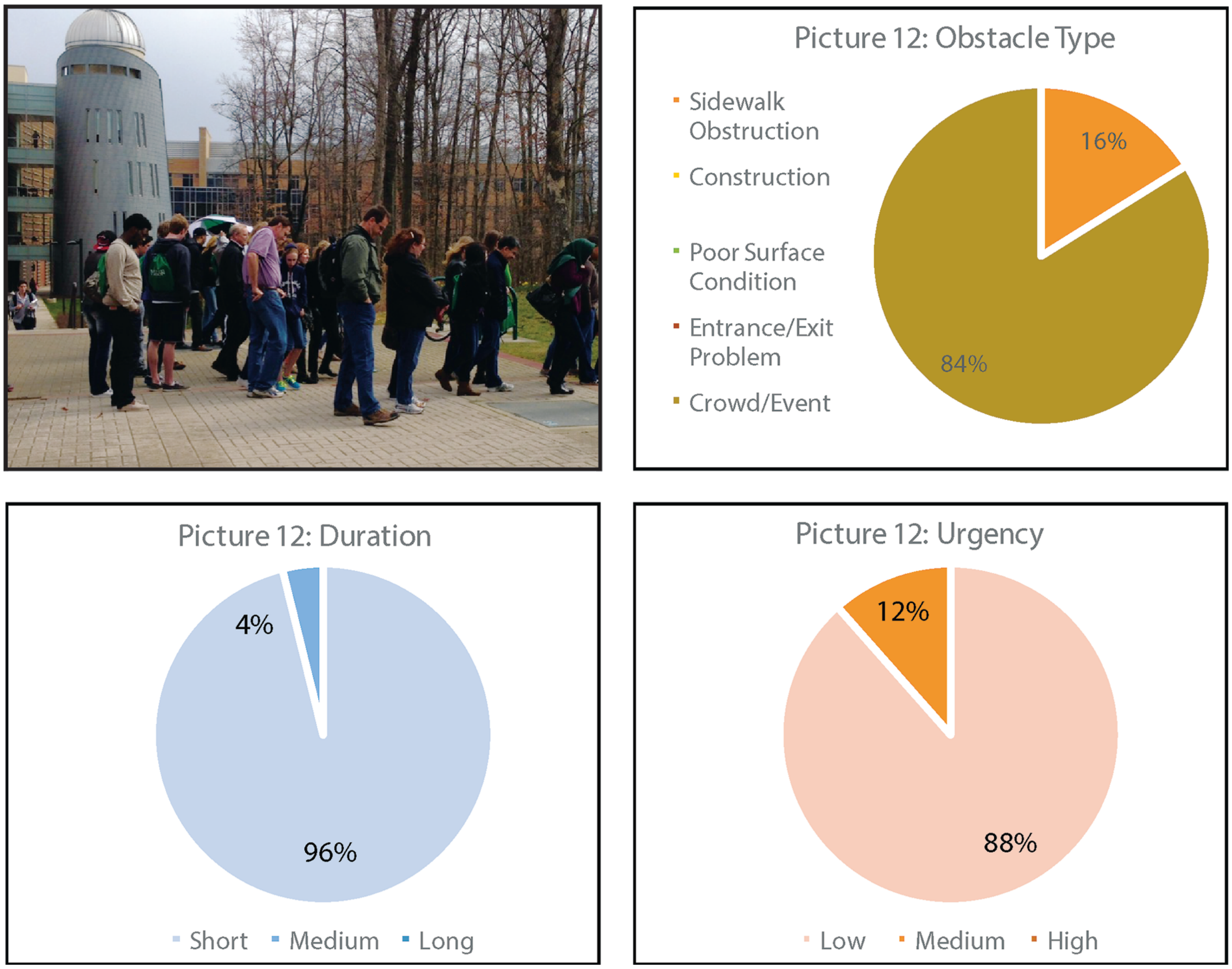


Figure 2. Relative consensus on the selection of obstacle type, duration, and urgency for GMU-GcT contributors, $n = 26$

2016), and Rice (2015), requires that the data contributor define the attributes of an obstacle. While a moderator can correct any discrepancies, the quality assessment process is slower and less efficient than it could be. At the same time, the lengthy reporting process has been noted in contributor feedback and surveys as a disincentive. Contributors report a preference for streamlined contribution processes, and while they report that they are willing to use a more detailed reporting process if it generates better quality assessment information, they prefer a simpler and quicker contribution workflow.

GMU-GcT Redesigned: Simplification and Mobile Image Sharing

Goodchild and others (2007), and later Longley and others (2015), formulated a concept of the atomic element of geographic information, which is stated to be a triple of location (x, y), time, and attribute. Longley and others use this concept in their textbook to discuss the georeferencing process (assigning location to time and attribute), as well as other fundamental issues of geographic representation. The quality assessment workflows in the GMU-GcT target the broader elements of quality addressed previously, but focus on elements related to the validation of location, time, and attribute. The simpler "Image Share" reformulation of the GMU-GcT contribution tools, tested in fall 2016, suggests that it is possible to retain a quality assessment workflow for location, time, and attribute. The quality assessment parameters in the GMU-GcT testbed are shown in Table 2, along with the same elements in the Image Share tool. For the thorough reporting process embodied in the GMU-GcT Desktop and Mobile tools, we are able to calculate quality assessment parameters for location (a comparison of the user-supplied or asserted position with the actual location), location description (a text-based description of an obstacle's location), temporal consistency, obstacle type/duration/urgency, and three quality measures associated with the report itself: image quality, completeness, and an assigned moderator quality score.

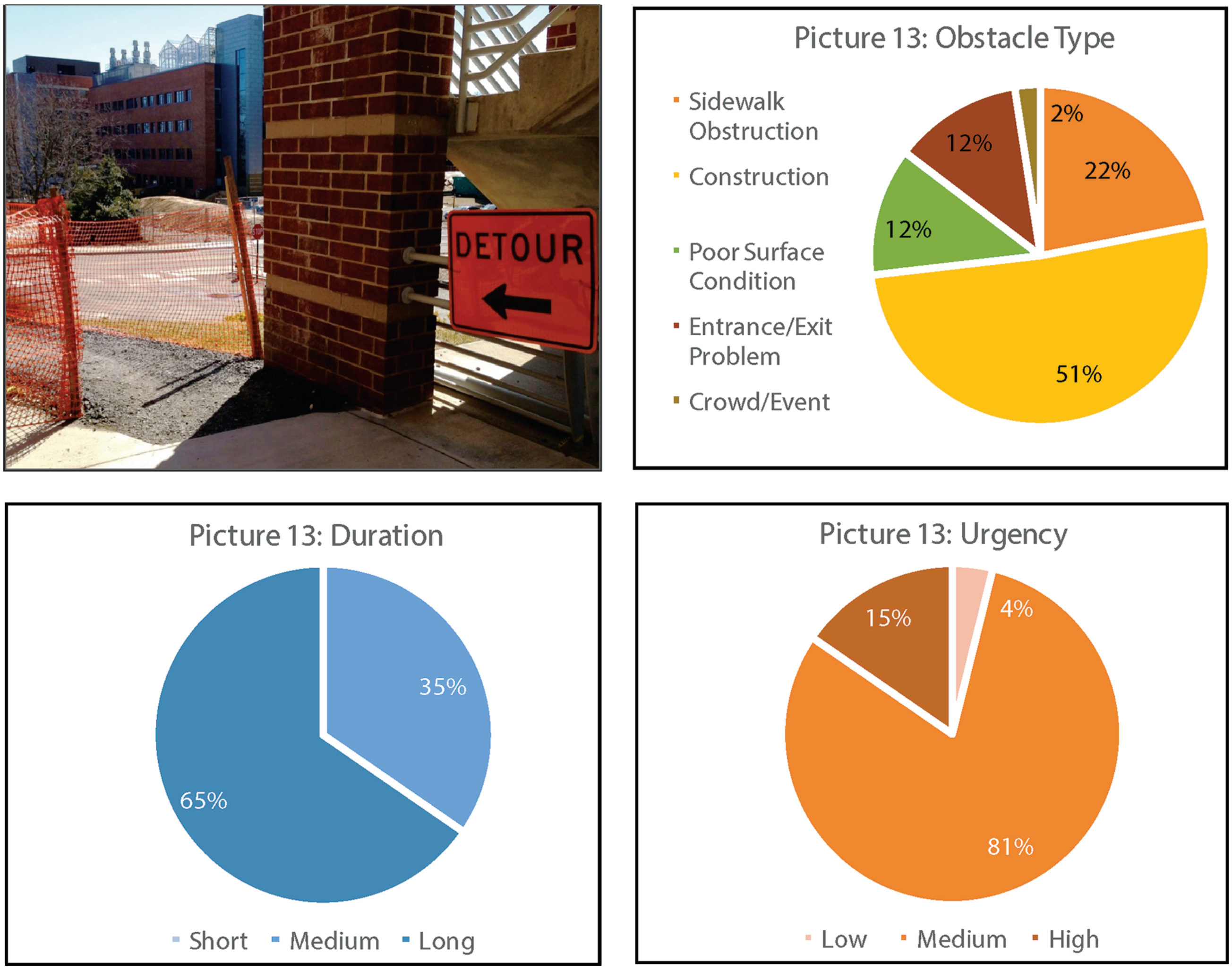
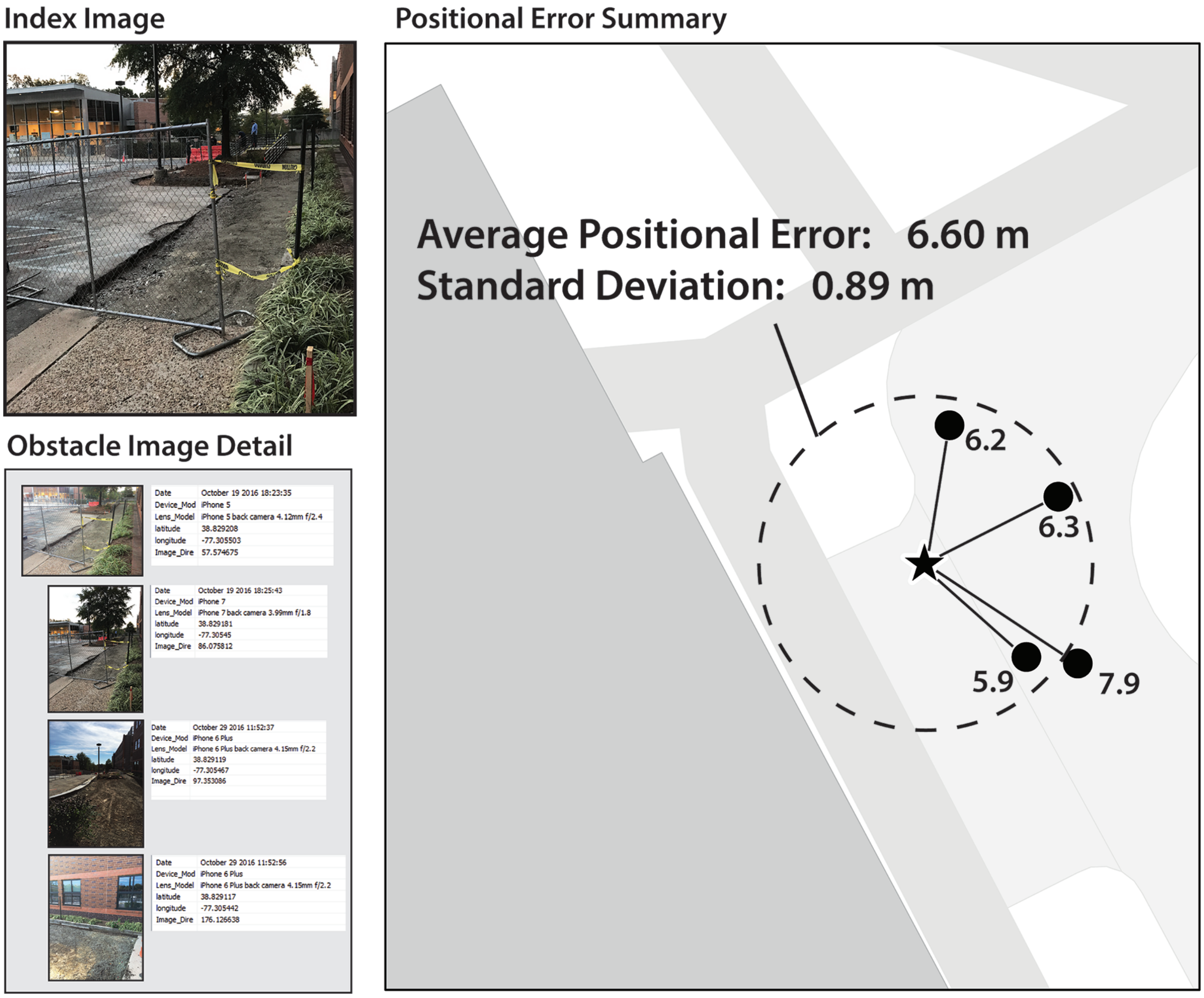


Figure 3. Disagreement on obstacle type, duration, and urgency in the GMU-GcT

Table 2. Quality assessment elements in the evolving GMU-GcT

	Desktop/mobile	Image share
QA: Location (X, Y)	Metric	Derived
QA: Location text	Binary	Binary-complex
QA: Temporal consistency	Binary	Derived
QA: Obstacle type	Categorical	Not applicable
QA: Duration	Categorical	Not applicable
QA: Urgency	Categorical	Not applicable
QA: Image quality	Ordinal	Ordinal
QA: Completeness	Metric	Not applicable
QA: Moderator quality score	Ordinal	Not applicable

This thorough reporting process, presented in Qin and others (2015, 2016), is significant for providing information used to derive quality assessment measures for nearly every facet of geospatial quality articulated by Guptill and Morrison (1995) and Veregin (1999). The streamlined “Image Share” reformulation of the GMU-GcT provides fewer direct measures of uncertainty, but does provide several (Table 2). The quality assessment parameters used in both systems are grouped in Table 2 by their association with location, time, and attribute, with general report quality measures at the end.



Date	October 19 2016 18:23:35
Device_Mod	iPhone 5
Lens_Model	iPhone 5 back camera 4.12mm f/2.4
latitude	38.829208
longitude	-77.305503
Image_Dire	57.574675

Date	October 19 2016 18:25:43
Device_Mod	iPhone 7
Lens_Model	iPhone 7 back camera 3.99mm f/1.8
latitude	38.829181
longitude	-77.30545
Image_Dire	86.075812

Date	October 29 2016 11:52:37
Device_Mod	iPhone 6 Plus
Lens_Model	iPhone 6 Plus back camera 4.15mm f/2.2
latitude	38.829119
longitude	-77.305467
Image_Dire	97.353086

Date	October 29 2016 11:52:56
Device_Mod	iPhone 6 Plus
Lens_Model	iPhone 6 Plus back camera 4.15mm f/2.2
latitude	38.829117
longitude	-77.305442
Image_Dire	176.126638

Figure 4. Positional error summary of four images contributed with the Image Share tool

The Image Share Tool in the GMU-GcT allows a derived measure of location quality, based on collections of images showing the same obstacle. Figure 4 shows four images recently contributed to the GMU-GcT using the Image Share tool. The positional quality assessment consists of the identification and clustering or image-based reports, followed by the extraction of location data from the embedded image EXIF metadata. A moderator checks the reports through an inspection of content, establishes the actual locations through a field position validation, and obtains positional error estimates through a comparison of original, submitted locations with the moderator's field-checked location (Figure 4). The moderator's workflow, discussed in detail by Qin and others (2015) and Rice (2015), is based on Goodchild and Li's social moderation workflow (Goodchild and Li 2012), where location and attributes for geocrowdsourced data are checked, updated, and corrected by a trained moderator.

Additional location validation for quality assessment is captured in three additional ways. First, the orientation vectors from the image EXIF data are extracted and plotted to determine whether they intersect. This is based on the premise that if electronic compass information is accurate and the report contributor is pointing a phone at the obstacle, the location and direction vectors can be used to identify the position of the obstacle. Figure 5 shows a hypothetical case of this approach, while Figure 6 demonstrates that in practice, it does not work dependably. The quality of electronic compass bearings embedded in image EXIF data is currently not good enough to make this a dependable approach. Experimentation with high-quality GPS and electronic compass hardware used with DLSR cameras does show promise (Rice and others 2015), and this approach may be feasible with future improvements in mobile device hardware. Second, the short text description of the obstacle supplied in response to the "What?

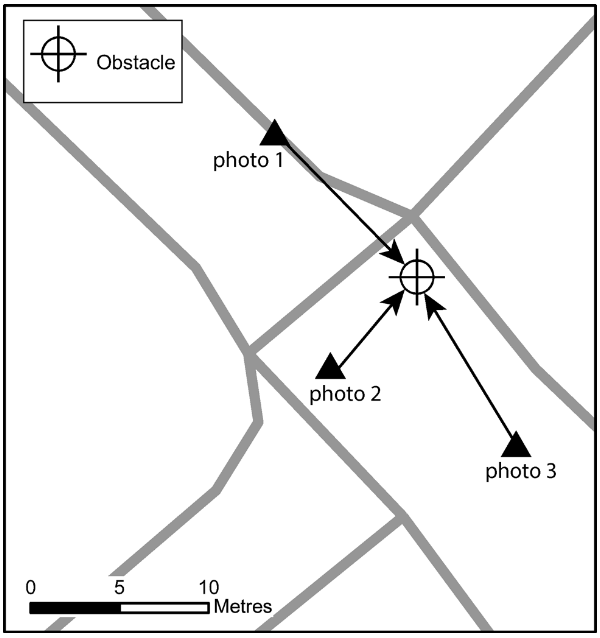
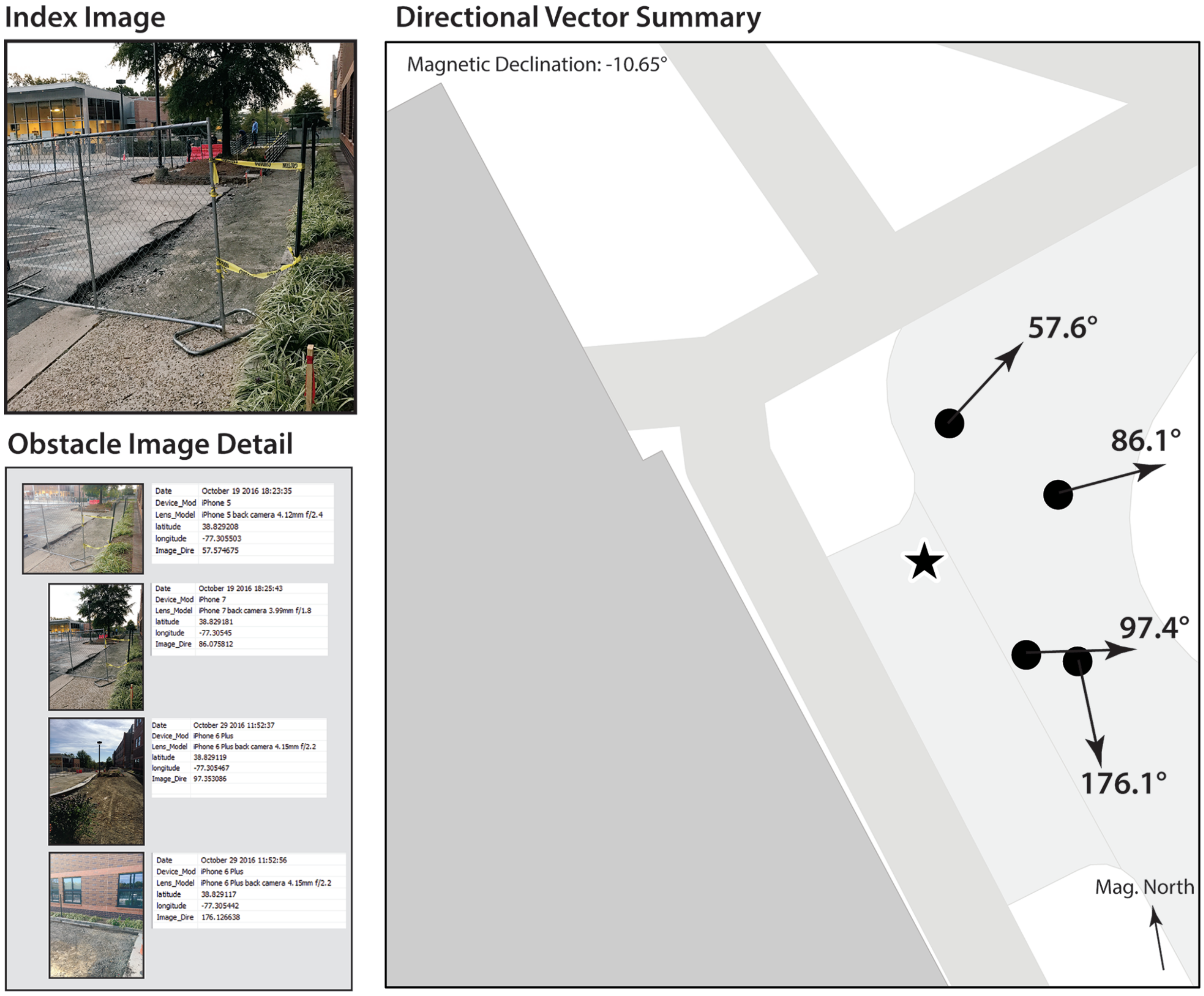


Figure 5. Direction vectors extracted from image EXIF data intersecting at the location of an obstacle


Index Image

Directional Vector Summary

Obstacle Image Detail

Date	October 19 2016 18:23:35
Device_Mod	iPhone 5
Lens_Model	iPhone 5 back camera 4.12mm f/2.4
latitude	38.829208
longitude	-77.305503
Image_Dire	57.574675

Date	October 19 2016 18:25:43
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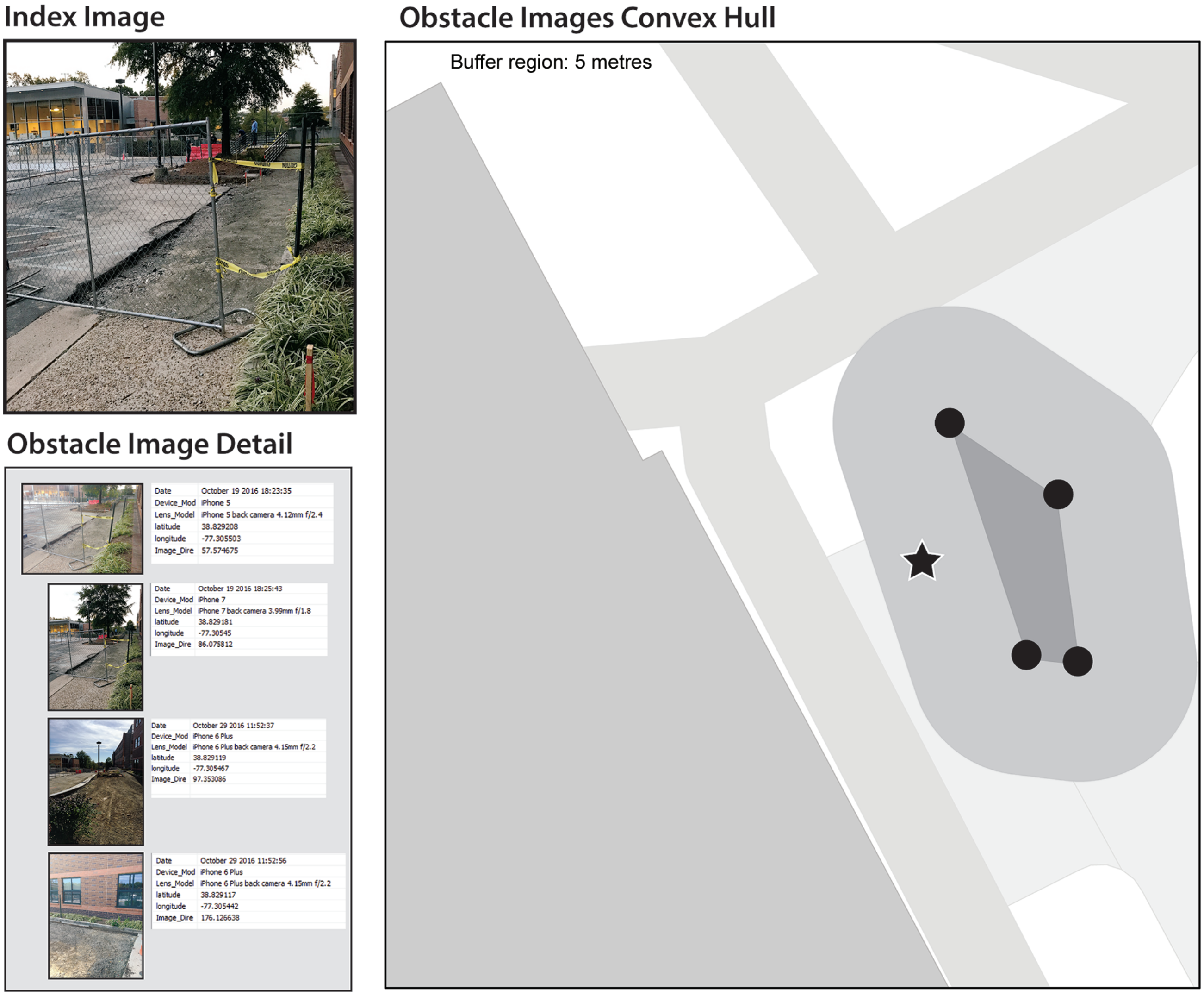
Date	October 29 2016 11:52:56
Device_Mod	iPhone 6 Plus
Lens_Model	iPhone 6 Plus back camera 4.15mm f/2.2
latitude	38.829117
longitude	-77.305442
Image_Dire	176.126638

Figure 6. Image position and orientation vectors from the Image Share tool



Index Image

Obstacle Image Detail

Date	October 19 2016 18:23:35
Device_Mod	iPhone 5
Lens_Model	iPhone 5 back camera 4.12mm f/2.4
latitude	38.829208
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longitude	-77.305442
Image_Dire	176.126638

Obstacle Images Convex Hull

Figure 7. Image footprint convex hull with 5-m buffered obstacle region

Where?" prompt is geoparsed for distances, directions, and specific place name entries contained in a detailed local gazetteer. This method results in an obstacle footprint and is explained in detail in Aburizaiza and Rice (2016), who have implemented an automated geoparsing workflow to generate footprints from obstacle descriptions. The third approach to assessing the quality of location in the Image Share tool of the GMU-GcT involves the generation of a convex hull from the location data stored in mobile device image EXIF metadata. Figure 7 shows the convex hull for the four images, and an associated 5-m obstacle buffer region. This 5-m distance is based on the typical uncertainty in crowdsourced location data, as measured by Girres and Touya (2010), Haklay (2010), and others, as well as general uncertainty information associated with mobile device GPS positioning studied and tested by the research team (Rice and others 2015). The 5-m distance, applied to the collection of contributed reports, creates a buffered region that is likely to contain the reported obstacles, and serves as a proxy for areal features that are reported as collections of points. This distance can be adjusted as evidence appears suggesting a new approach, or field testing suggests that obstacle avoidance, a main motivation of this work, requires a new approach. As a note, in the navigation of geographic space, accessibility issues that impede successful navigation are a combination of obstacle avoidance, the focus of the work here, and the ability to maintain a holistic overview of the configuration of the area that they wish to traverse. Kitchin, Jacobson, and Blades (1998), working with individuals without sight, found that an obstacle as small as 1 m × 2 m was significant enough to provide local situational confusion, and provided enough disorientation to impede the successful traversing of a geographic area. The 5-m buffered region (Figure 7) is the current optimal estimate associated with all of these factors.

The three general approaches presented in this section and shown in Figures 5, 6, and 7 allow a positional quality assessment measure to be derived. The quality assessment for temporal consistency is derived from a comparison of the image date–time stamps with the report submission dates and times, with a quality score preference for contributions made to the GMU-GcT at the same time or shortly after the image was captured. Additional quality measures, such as general image quality, are determined by the moderator (Figure 4).

Conclusions and Future Work

The GMU-GcT was developed to capture transient obstacle data in the local built environment, with a focus on the pedestrian network. This obstacle data are generated through geocrowdsourcing and then validated and quality checked by moderators. The validated data then can be used by blind, visually impaired, and mobility-impaired individuals to plan routes, avoid obstacles, and gain spatial awareness in a rapidly changing environment. The process of contributing obstacle reports is time-consuming, but allows the generation of a comprehensive set of quality assessment measures that provide information about each obstacle report's location, time, and attributes. A new version of the contribution tool, referred to as the GMU-GcT Image Share tool, was created to dramatically simplify and speed up the contribution process. The advantages of the tool are (1) the removal of obstacle attribute reporting, which has been difficult, and (2) the simplicity and speed of the reporting process. The only required contribution element in the Image Share tool is an image, and a simple answer to a "What? Where?" prompt. Information about obstacle location, time, and attributes can be determined through mining image EXIF metadata and through moderator assessment. Quality assessment can be done with this process, but some approaches, such as the use of image direction vectors, show mixed or poor results.

The motivation for revising the GMU-GcT in this manner is to simplify the contribution process and therefore increase the number of contributions, and to replicate the benefits of simplified interfaces for accessibility (Brittell, Young, and Lobben 2013). The social dynamics of the crowdsourcing process, informed by the research of Coleman, Georgiadou, and Labonte (2009) Coleman, Sabone, and Nkhwanana (2010), and Elwood, Goodchild, and Sui (2012), is of great interest and will be the subject of future work. A strategic change in the nature of an established crowdsourcing platform can have both positive and negative consequences, and while some of the quality assessment techniques have been explored and presented here, much work is left to be done. The overarching goal of this work is to produce high-quality obstacle data that can be incorporated into any local mapping workflow or accessibility platform. Our hope is that some of the lessons learned and positive results can be incorporated into other projects.

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