SIG: Making Maps Accessible and Putting Accessibility in Maps

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Abstract

Digital maps represent an incredible HCI success—they have transformed the way people navigate in and access information about the world. While these platforms contain terabytes of data about road networks and points of interest (POIs), their information about physical accessibility is commensurately poor. Moreover, because of their highly graphical nature and reliance on gesture and mouse input, digital maps can be inaccessible to some user groups (*e.g.,* those with visual or motor impairments). While there is active HCI work towards addressing both concerns, to our knowledge, there has been no direct effort to unite this research community. The goal of this SIG is threefold: first, to bring together and network scholars and practitioners who are broadly working in the area of accessible maps; second, to identify grand challenges and open problems; third, to help better establish accessible maps as a valuable topic with important HCI-related research problems.

Author Keywords

Accessibility, geography, maps, urban informatics, GIS, navigation, tactile graphics, mobility, GeographicHCI

ACM Classification Keywords

K.4.2 Social Issues: Assistive technologies for persons with disabilities; H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

Figure 1. *Wheelmap.org* collects and visualizes the wheelchair accessibility of POIs such as bus stops, restaurants, and public bathrooms. Image courtesy SOZIALHELDEN e.V. (http://wheelmap.org/).

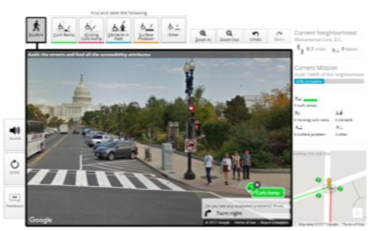

Figure 2. *Project Sidewalk* [13] is an online tool that collects data about sidewalk accessibility via remote crowdsourcing and virtual walkthroughs of city streets. Image courtesy Project Sidewalk (http://projectsidewalk.io/).

Introduction & Motivation

Digital maps such as *Google Maps*, *Yelp*, and *Waze* represent an incredible HCI success—they have transformed the way people navigate in and access information about the world [9]. While these platforms contain terabytes of data about the environment, their information about physical accessibility is comparably poor. Indeed, most contain little-to-no information about the accessibility of street infrastructure (*e.g.,* streets, sidewalks), buildings (both entryways and interiors), or recreational areas (*e.g.,* parks and trails). In addition, because of their highly graphical nature and reliance on gesture and mouse input, these systems can be inaccessible to some user groups (*e.g.,* those with visual or motor impairments).

Thus, at a high-level, there are two key accessibility problems: (1) collecting and integrating accessibility information about the physical world into maps, and (2) ensuring that the maps are accessible to diverse users across a wide range of physical, sensory, and cognitive abilities. While there is active research in HCI (and beyond) towards addressing both concerns, to our knowledge, there have been no direct efforts to unite this research community. The goal of this SIG is threefold: first, to bring together and network scholars and practitioners who are broadly working on accessible maps; second, to identify grand challenges and open problems; third, to help better establish accessible maps as a valuable topic with important HCI-related research problems within the SIGCHI community. While our primary focus is accessibility, our hope is also to attract researchers who broadly work in the area of *GeographicHCI* [9].

Background & Related Work

In many regions of the world (*e.g.,* US [15], EU [6]), legislation mandates that the built environment be accessible—*e.g.,* curb ramps must have friction strips for blind travelers with sufficient width and low grade for wheelchair users. Despite such policies, many parts of urban infrastructure remain inaccessible—from sidewalks and trails to business entryways and interiors. Just as critically, this information is not encoded in modern mapping tools.

Putting accessibility into maps. How should physical-world accessibility be sensed, tracked, and integrated into GIS (Geographic Information Systems) tools—and how can this be done at different scales? City transit departments and, less formally, community organizations conduct street audits that assess walkability and pedestrian access; however, this data is typically not freely available, has disparate formats, and is not intended for end-user tools.

In contrast, applications such as *SeeClickFix* and *Wheelmap.org* (Fig. 1) enable volunteers to assess and report location-based accessibility information *in situ* using smartphones, which are then viewable online; however, these tools often suffer from data sparseness issues. For example, Ding *et al.* [4] found that only 1.6% of the POIs in *Wheelmap.org* had accessibility data. To increase scalability, Froehlich *et al.* have explored remote crowdsourcing approaches (*e.g.,* using *Google Street View* [13]; Figure 2) as well as automated methods using computer vision [8], but both provide fewer details than *in situ* physical assessments. Others have also investigated automated assessment (*e.g.,* [1])—though promising, this research area is in very early stages.

Figure 3. *NavCog3* [14] is an open source smartphone-based indoor navigation system for people with visual impairments. An auditory interface provides turn-by-turn directions and immediate feedback when incorrect orientation is detected. Image courtesy NavCog (http://www.cs.cmu.edu/~NavCog/navcog.html).

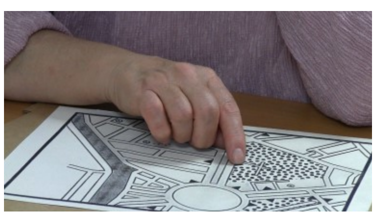

Figure 4. A visually impaired user exploring a tactile map.

Once data about physical-world accessibility is sensed or reported, it needs to be in a usable, standardized format. *OpenSidewalks* is focused on creating an open standard for pedestrian pathways, which includes accessibility standards [12]. Similarly, *Wayfindr* [11] is creating an open standard for audio-based wayfinding that includes POIs and landmarks that are relevant for navigation-based assistive technologies. Current projects, such as *NavCog* (Fig. 3) are using this knowledge both on real-world [14] and virtual [7] navigation apps for blind people. Besides wayfinding, broader work needs to be done to support a wide range of useful assistive applications, including: accessibility-aware POI search, personalized routing along accessible paths (similar to *accessmap.io* [3]) and interactive visualizations of neighborhood accessibility (similar to *Walkscore.com* but with accessibility information).

Making maps accessible. Maps are inherently graphical and digital tools rely on gestures and complex mouse inputs for interactivity, which can limit use by those with visual, motor, or cognitive impairments. Blind people have been using tactile maps with braille legends for many decades [10] (Fig. 4). More recently, accessible interactive maps [5] and models (Fig. 5) have been developed. Some technologies have been adopted commercially (*e.g., IVEO* uses tactile graphics as in Fig. 4 as overlay over a touch display). More recent research has attempted to integrate emerging technologies such as tangibles and augmented reality [2] (Fig. 6). Yet, many challenges remain—*e.g.,* how to integrate tactility into mobile devices? How to ensure broad access to these inclusive systems?

Open Challenges

Building on the work above, a key goal of this SIG will be to identify open challenges in the area of accessible maps. We present an initial list to seed discussion:

Data collection. How do we collect, validate, and maintain data about the accessibility of the world?

Modeling. How can we then use this data to create computational models that accurately describe the accessibility of the physical world and can, consequently, be used in GIS systems?

Personalization. How can these models be parameterizable to meet the needs of different users (*e.g.,* visually-impaired *vs.* mobility-impaired)?

Access. How can we ensure that the maps themselves are broadly accessible to everyone (*e.g.*, to people with cognitive impairments, to screenreaders)?

Data interoperability. How can this data and these models be fed back into mapping services like OpenStreetMaps or commercial tools like Google Maps?

Emerging technology. How may emerging technology like autonomous vehicles, precise 3D mapping via LiDar, and high-resolution satellite imagery change the way we collect, visualize, and use accessibility data?

User foci and inclusive design. In preparing our submission, we observed a disproportionate focus in the accessible maps literature on users with visual or motor impairments while overlooking cognition, literacy, and language. What are the key user requirements for each group and design implications?

SIG Meeting Agenda

We propose the following 80-minute agenda:

- **Introduction.** We will begin with an overview, rapid 1-minute introductions of the co-organizers and their work, and an ice-breaker activity (15 mins).

Figure 5. Perkins School for the Blind: Talking Campus model by Touch Graphics.

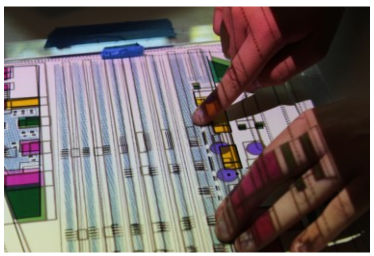

Figure 6. A visually impaired user exploring an interactive map for visually impaired people based on Augmented Reality [2] (Project VISTE http://www.visteproject.eu/).

- **Small group brainstorm (challenges).** Break into small groups to brainstorm and discuss key challenges in the area of accessible maps. Each group will be seeded with a separate list of initial ideas to ensure topic coverage. (15 min).
- **Present & discuss.** Each group will present to the collective and lead a small discussion. A live Google Doc projected on a shared display will be maintained to keep notes. (17.5 min).
- **Small-group brainstorm (towards solutions).** Once all groups have presented, attendees will prioritize the top ~5 key challenges and again split into small groups to discuss solutions. (15 min).
- **Closing discussion.** We will again reconvene as a room and discuss potential solutions, key future research topics, and a submission to the SIGACCESS newsletter about the SIG. Contact information will be shared via the Google Doc. (17.5 min).

Expected Outcomes

We expect this SIG to influence and establish future research in the area of accessible mapping. We hope to inspire new projects, collaborations, and workshops. We will compose a summary of the SIG and submit to *ACM Interactions* or *ACM SIGACCESS Newsletter* to reach the broader community and further engagement.

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