Towards Disability-Inclusive Built-Environment Navigation & Policy

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HCI advances in digital mapping have revolutionized how people navigate the built environment, granting most users unparalleled ease of access to new and familiar places. Unfortunately, such innovations have not created commensurate opportunities for people with disabilities. Despite the plethora of HCI advances in manual and automated mapping methods, no mapping platform has scaled with data about pedestrian disability access. This points to a need for a more efficient and successful data collection method for pedestrian navigation related to disability access. Furthermore, most interventions are not connected to the local government organizations whose job is to maintain and build the city infrastructure. Given that disabled people already face disproportionate barriers to finding information and access to cities worldwide, mapping technologies that continue to advance in non-inclusive ways only exacerbate inequalities in access to public space within this marginalized community and others. This paper argues for the need to fill this gap, identifies current sticking points, and calls for partnerships between HCI and policy to explore commercial communities to work on solutions that can increase mapped data on accessibility and use that data to inform better-built environment policy.

CCS CONCEPTS • People with disabilities • Human-centered computing • Accessibility

Additional Keywords and Phrases: Disability access, mapping, navigation, policy

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1 INTRODUCTION

Due to the advent of publicly available digital navigation systems, accessing information about the built environment is easier than ever. HCI advances have transformed our reliance on paper-based maps into a landscape of increasingly complex and user-friendly digital navigation systems [13] such as Google Maps [6], CityMapper [4], and more. However, the wide array of data collected and made available via such platforms do not yet include features relevant to navigating the built environment with a mobility disability. Sidewalks riddled with holes or blocked by obstacles, entrances into public buildings marked by stairs, and city blocks without ramps or tactile pavement can leave these individuals with little access to public life – and these barriers are not yet mapped in the same way that non-disability-specific barriers, like a full lack of pavement or a closed bus stop, already are.

To tackle this issue several HCI researchers have explored ways to crowdsource or otherwise map city-accessible infrastructure items, e.g. step-free entrances to places of interest [8,9,16]. However, many of these maps are only available in global North settings and have extremely limited coverage. This means that disabled people are being left behind in some ways HCI is revolutionizing navigation and mapping, further widening the already large gap in access to public space and citizenship experienced by this community.

Given that disabled people already face disproportionate barriers – especially in low resource settings – to finding information and access to cities worldwide, it is important to examine how and why available technologies are advancing without meeting this community's needs, with the goal of more inclusive future innovation. Thus, in this short position paper we first highlight related work at the intersection of disability access and digital mapping, then clarify the current gaps and their consequences, before exploring potential paths forward and their challenges. Finally, we call for partnerships between HCI practitioners, commercial mapping platforms, and policymakers to not only gather more data about access in the built environment but use that data to inform policy about implementing disability access.

2 RELATED WORK

Over the last decade, there have been several notable innovations that sought to use digital mapping technologies to facilitate navigation by disabled people, primarily those with mobility and vision disabilities. Specialized apps like Sociability [15], AccessNow [1], and AccessAble [5] provide data about shop and restaurant access for a range of disability needs. Similarly, mainstream navigation apps like Google Maps [6] and CityMapper [4] have options to select a "step-free" or "wheelchair accessible" route when navigating – but these features only provide data on transit accessibility (buses, subways, etc.) [2,3], meaning that directions may still lead users via pedestrian routes with stairs or other access barriers. Only a few initiatives, like Project Sidewalk, focus on pavement quality and accessible pedestrian routes [10,14]. However, these rely on crowdsourcing or manual surveying, methods of data collection which are "time-consuming, laborious, and expensive" [20].

Automated methods of data collection are already common among mainstream mapping platforms, often using computer vision or other remote sensing to gather data on permanent or temporary pedestrian conditions [11,12,18,19]. While initial HCI attempts to use automated methods to map disability access features had low precision and recall [17,20], more recent work has combined manual and automated methods to reach a level of performance similar to manual-only labelling, but in a reduced amount of time [17,20]. It is worth noting, however, that successful attempts that involve automation seem to be limited to detecting curb cuts (rather than other access features), are limited to Global North cities, and still lack scalability for efficient worldwide data collection.

3 UNDERSTANDING THE PROBLEM

While mapping transit access has advanced significantly in mainstream platforms like Google Maps and CityMapper, acute gaps continue in data regarding access to buildings and on pedestrian routes across pavement. And even in the case of transit in Google Maps, users who select "wheelchair accessible route" are greeted by a warning to "Use caution—wheelchair-accessible directions may not always reflect real-world conditions" (Figure 1). Such a warning is not present if the user navigates via the default route.

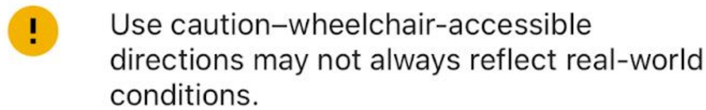

Figure 1: Screenshot of Google Maps [6] mobile app warning regarding wheelchair accessible routes function.

Existing methods of data collection with respect to accessibility seem to face a trade-off among five factors:

- **Accuracy**: How well does the data reflect real-world conditions?
- **Speed of collection**: How quickly can the data be collected?
- **Geographic coverage**: Is data consistently available across different geographic areas?
- **Plenitude/comprehensiveness**: Is the data complete enough to enable navigation (i.e. not just including one dimension of accessibility)?
- **Cost**: How costly is the method?

For instance, crowdsourcing methods, as used in apps like AccessNow [1] and Sociability [15], tend to score low across all four dimensions but are often used due to their low cost. Meanwhile, manual expert surveying tends to have high accuracy and plenitude but also high cost, low speed of collection, and low geographic coverage. On the other hand, automated remote-sensing attempts using computer vision have been relatively low cost, higher speed, and with a higher potential for geographic coverage. Still, they have thus far had low accuracy and plenitude. Hara et al. 2014 [9] combined automated curb-cut detection with manual validation to achieve higher accuracy and speed, but this method is still costly and limited in its plenitude. Thus, as illustrated by Figure 2 (Appendix 1), there is no clearly advantageous method for *how* exactly to begin collecting this data with the current technology we have used thus far.

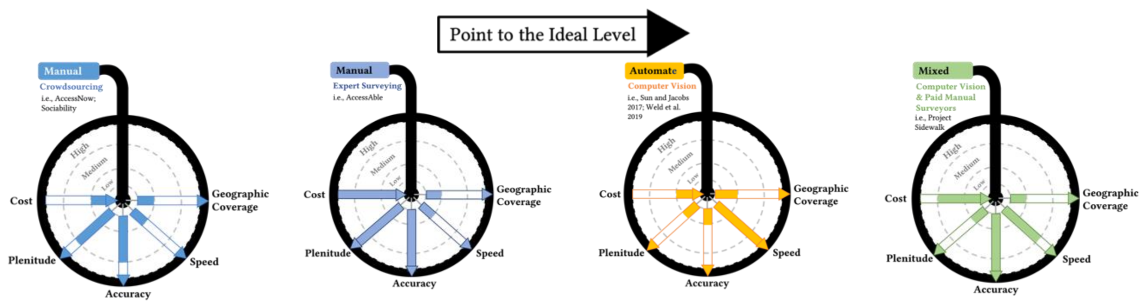

Figure 2: A diagram illustrating the trade-offs of existing accessibility mapping platforms across five criteria.

Therefore, we believe we need to develop a fresh approach to the collection of accessibility data which will make cities more accessible for mobility device users and any other wheeled mobility users. This will necessitate brainstorming and innovation to find a suitable solution. We believe this needs to start with a closer link between the policymakers, those who implement these policies at a city level, and wheeled-mobility users. Figure 2 shows the current tradeoffs within each currently-available method.

4 NEED FOR PARTNERSHIP

Digital mapping technologies that continue to advance in non-inclusive ways will exacerbate inequalities in access to public space among the disability community. To avoid these consequences, we call for a partnership of HCI practitioners, commercial mapping platforms, and policymakers working in built-environment access to discuss opportunities to fill the gap in mapping mobility access features.

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