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Enhancing Urban Accessibility: Participatory Mapping and Technology for Inclusive Digital Maps

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Abstract:

People with mobility restrictions, such as wheelchair users or individuals with age-related impairments, often face challenges when planning walking routes using current digital maps. This is because most digital maps and routing services are designed for the general population, overlooking the specific needs of those with mobility impairments, particularly regarding built environment elements. A key issue is the lack of spatial accessibility features—street elements that can either facilitate or hinder mobility depending on a person's movement capabilities (Neis and Zielstra, 2014). Examples include sidewalk width, surface conditions, and curb ramps. To address this, it is essential to enrich and maintain up-to-date datasets that incorporate these accessibility features. Traditional field-based methods for data collection, however, are often costly and time-consuming. As an alternative, participatory mapping offers an efficient and scalable solution for gathering such data, while enhancing the inclusivity of maps.

In our previous citizen science project, ZuriACT (Allahbakhshi, 2023), a collaboration between the City of Zurich and the University of Zurich, we laid the groundwork for the sustainable enrichment of spatial accessibility data. To do this, we used digital web applications, including Project Sidewalk (Saha et al., 2019), developed by researchers at the University of Washington, and an extended version of infra3D (infra3d web-client, 2025) implemented by the Swiss company (iNovitas, 2025). These applications enable virtual auditing and remote accessibility data collection using street-view images. This initiative aimed to contribute to filling the critical accessibility data bias in the study area of District 1 of the City of Zurich. By involving individuals with specific needs, such as adults with mobility impairments (e.g., wheelchair users), age-related mobility restrictions, and situational mobility restrictions (e.g., caregivers of wheelchair users and parents with pushchairs) in the data collection design and process, we ensured that the collected data reflected their requirements and priorities. Our study demonstrated the potential of participatory mapping to create more inclusive, user-centered digital maps. By involving individuals with specific needs—such as adults with mobility impairments (e.g., wheelchair users), age-related mobility restrictions, and situational mobility challenges (e.g., caregivers of wheelchair users or parents with pushchairs)—in the design and data collection process, we ensured the data accurately reflected their priorities and requirements.

Building on this initiative, our follow-up project, ZuReach: Zurich Urban Reachability & Accessibility Enhancement through Digital Technology, aims to broaden the scope of inclusive mapping by applying participatory methods. ZuReach will be developed using a collaborative, co-creative approach, ensuring the continued participation of population groups with mobility restrictions. This approach empowers these groups to actively engage in decision-making processes, contributing insights into a more inclusive city and playing a vital role in shaping the future of their built environment. Additionally, we seek to develop a new web-based tool that uses virtual crowdsourcing to collect detailed accessibility data on sidewalks. This tool will integrate and enhance the functionalities of the above-mentioned web applications, creating a more comprehensive and inclusive mapping platform. It will also address a larger geographical area than the original study, enabling broader coverage and greater impact.

The data gathered through this platform will form the basis for inclusive digital maps and personalized routing services. With the inclusion of additional data generated by this initiative, new and previously unexplored questions in the realm of spatial accessibility can be examined. Furthermore, it will support the development of advanced techniques, including semi-automation of accessibility data detection through deep learning. These innovations are essential for scaling inclusive digital maps, extending their benefits to a wider range of users and regions, and fostering a more inclusive environment.

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