Towards an Inclusive Urban Environment: A Participatory Approach for Collecting Spatial Accessibility Data in Zurich

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Abstract

The unprecedented rate of urbanization, along with the increase in the aging and disabled populations, bring about an increasing demand for public services and an inclusive urban environment that allows easy access to those facilities. Spatial Accessibility is a measure to assess how inclusive a city is and how easily public facilities can be reached from a specific location through movement in physical space or built environment.

A detailed geodata source of accessibility features is needed for reliable spatial accessibility assessment, such as sidewalk width, surface type, and incline. However, such data are not readily available due to the huge implication costs. Remote crowdsourcing data collection using Street View Imagery, so-called 'virtual audits' have been introduced as a valid, cost-efficient tool for accessibility data enrichment at scales compared to conventional methods because it enables involving more participants, saving more time by avoiding field visits and covering a larger area.

Therefore, in our pilot project, ZuriACT: Zurich Accessible CiTy, with the help of digital tools that allow for virtual inspections and measurements of accessibility features, we want to contribute to collecting and enriching accessibility information in the city of Zurich embedded in a citizen science project that will have both scientific and social impacts.

With the help of additional accessibility data produced in this project, the issues of an inclusive urban environment can be demonstrated by mapping the potential spatial inequalities in access to public facilities for disabled or restricted people in terms of mobility. Thus, this project provides helpful insight into implementing policy interventions for overcoming accessibility biases to ensure equitable services, particularly for people with disabilities, and contributes to creating an inclusive and sustainable urban environment. It goes without saying that an inclusive city is beneficial and impacts the quality of life of not only the population groups mentioned above but also the society at large.

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1 Introduction

It is projected that by 2050, about 70 percent of the world's population will live in urban environments, 15 percent of them will live with disabilities [10]. Moreover, the prediction shows that by 2050, the number of older people will reach 2 billion worldwide [12]. The unprecedented rate of urbanization, along with the increase in the aging and disabled populations, bring about an increasing demand for public services and access to those facilities. Depending on the infrastructure and design, the urban environment and physical

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space can facilitate or impede the mobility and accessibility of the aforementioned population groups and consequently affect their active social and physical participation in society as well as their quality of life [11]. Besides, promoting accessible built environments such as easy-access buildings and barrier-free sidewalks is a key element for sustainable and inclusive cities and is of high societal importance. But how can we measure the inclusivity of a city? Spatial accessibility, traditionally defined as the "potential of opportunities for interaction" [7] and more concretely understood as how easily destinations such as services (e.g., medical centers, grocery stores, and banks), friends, or places of social interaction can be reached from a certain location through movement in physical space, is one of the measures which is also a crucial factor for supporting active and healthy aging and mobility.

A comprehensive geodata source of accessibility features is a prerequisite for accurate spatial accessibility assessment and therefore, urban inclusivity measurement. Examples of accessibility features, i.e., spatial features impeding or facilitating accessibility, are sidewalk inclination, crossings, and ramps. Accessibility features are crucial to disabled and mobility-restricted persons' navigation and mobility. Still, they are usually not offered by commercial geodata providers [13] and are mostly not readily available in existing open-access geographic information databases such as Open Street Map (OSM) [5]. Moreover, existing routing services and digital maps, such as Google Maps and OSM, fail to provide practical guidance for the above-mentioned persons' navigation due to the lack of relevant information on the needs of these user groups, which results in incomplete routing results or results that may not always reflect real-world conditions [6].

Different data collection methods have been applied to address this data gap issue and support the mobility of persons with disabilities (e.g., wheelchair users, visually impaired persons), which are traditionally conducted on the field applying on-field surveys [13], sensors (e.g., Global Positioning System) [16, 9], or a wide range of mobile applications (e.g., Vespucci [20], Go Map!! [4], and StreetComplete [21]). However, during the last few years, with the widespread use of the Internet, remote data collection using Street View Imagery (SVI), so-called 'virtual audits' has emerged as a valid alternative to expensive and time-consuming field visits [17]. The most famous and popular service for providing SVI worldwide is Google Street View (GSV) which is a basis for most virtual audits [14, 17, 15]. Virtual auditing allows users to remotely and manually measure and collect accessibility features by virtually walking in the city using the SVIs.

Collecting and maintaining detailed and up-to-date geographical information on accessibility is a considerably laborious, time-consuming, and expensive process. Hence, public partners usually avoid investing in such costly data collection [13]. Applying collaborative technologies such as citizen science helps address this challenge. Compared to the physical-based traditional methods, the virtual audit tools are easy-to-use, time and cost-efficient, and suitable for collaborative data collection, allowing the participants, particularly those who do not have the opportunity to do field visits for data collection, comfortably and safely collect detailed data at a larger scale wherever and whenever they want.

As mentioned earlier, publicly available geographical data sources such as OSM lack a considerable amount of accessibility information. For example, based on a recent study, only 2.3 percent of the OSM footpath data in Zurich include the inclination or steepness [3]. Besides, to the best of our knowledge, there has been no comprehensive geodatabase or data collection of accessibility information for the city of Zurich. Also, the city has launched no participatory data collection campaign in that regard.

Therefore, in our participatory project titled: ZuriACT (Zurich Accessible CiTy), for the first time, with the help of virtual audits, we want to take the initiative and contribute to providing a systematic and enriched dataset of the accessibility features in the selected study

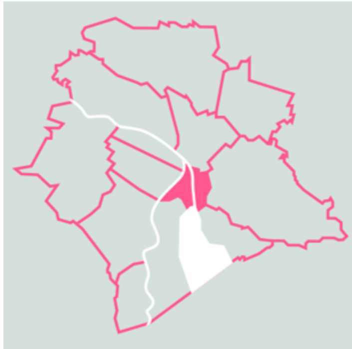

Figure 1 Study area: District 1 of the city of Zurich.

area of District 1 of the city of Zurich embedded in a citizen science project. District 1 of the city of Zurich (see Fig. 1) has been selected as the study area due to its topographical and geographic characteristics such as inclined streets, various public facilities (e.g., shopping streets, touristic attractions, main train station), a significant number of commuter populations, and centrality.

Also, we aim to contribute to a better understanding of spatial accessibility and its potential biases in the urban environment by providing an enriched accessibility database that can bring about essential information for reliable accessibility measurements, thereby equipping policymakers and urban planners with helpful insights into a more sustainable and inclusive environment for society, particularly persons with disabilities. Moreover, generating further new data can significantly contribute to scientific gaps in the accessibility analysis domain that have not been addressed so far due to a lack of appropriate, comprehensive open geographical data.

2 Method

2.1 Recruitment and Participants

A range of different marketing options will be used to inform citizens about the ZuriACT project idea, including the organization's websites (e.g., The City of Zurich, the organizations for people with disability, University of Zurich), e-newsletters, social media (e.g., LinkedIn, and Twitter), and distributing flyer in the study area. The communication and recruitment of citizens will also be conducted through the university webpage, where citizens can find further information about the project, as well as contact information and register for the study.

After screening the registered people based on the inclusion criteria, eligible participants will be contacted via email and asked to sign a consent form, including information about the study objectives and procedure, expected contribution, and participant compensation. Upon receipt of the informed consent, participants will be contacted to schedule meetings for different parts of the project, including focus group discussions and training sessions for data collection.

A total of 80–100 will be recruited for the study. As for eligibility criteria, participants must be cognitively healthy (assessed based on self-report) adults aged 18 and above, and belong to at least one of the population groups below:

1. Community-dwelling older adults aged 65 and above
2. Persons with situation mobility restrictions, such as parents with pushchairs
3. Mobility-disabled persons (e.g., wheelchair users)

2.2 Focus Groups

Our citizen science project focuses on co-creation, aiming to maximize the level of citizens' involvement in most or all stages of the project, including project design, data collection, and implementation [18]. To this end, we apply methods and tools for co-producing knowledge, such as focus group discussions [19]. In workshops, we bring together academics, citizens, and public and private partners to discuss the project's objective and contents, including initial ideation and data collection specifications. This helps gain experience from various perspectives and learn about the needs, knowledge, demand, and interests of different people involved in the project, laying the basis to adapt the project planning in a way that could be beneficial to all. An example of a similar initiative is the 'MIND Inclusion' project by Martínez-Molina et al. (2020), which focused on providing co-created accessible cognitive design tools for people with intellectual disabilities [8].

2.3 Spatial Accessibility Data Collection

We will use the Project Sidewalk tool for virtual audits by citizens. Project Sidewalk allows for collecting accessibility data at a large scale by anyone with an Internet connection and a web browser through GSV images. Examples of data that can be collected using this tool are "curb ramp", "missing curb ramp", "surface problems", "no sidewalk", "Obstacles in path", and "Others" [15]. Besides, it offers an excellent citizen science platform that allows laypersons to collect accessibility data comfortably via interactive onboarding and mission-based tasks. However, it lacks tools for collecting accessibility features that require measurements, such as sidewalk incline or width. Moreover, Project Sidewalk highly depends on GSV images which are sometimes outdated or do not cover the entire street network of the study area.

To address the data collection gaps using Project Sidewalk, we will use the Infra3D web-based tool [2], which is based on up-to-date and complete 3D SVI data "Strassenraum 3D" taken from car-mounted cameras from the entire city of Zurich developed by the Swiss company iNovitas [1] and also offers measurement tools. The "Strassenraum 3D" data has a higher and finer temporal resolution and spatial coverage than GSV and is updated every two years. The 3D images embedded in the infra3D web-based tool have been taken from an equipped vehicle and include all public roads (excluding motorways) and the whole tram network of Zurich city and selected cycle paths and squares. However, since Infra3D lacks a well-designed citizen science platform like Project Sidewalk, it might be challenging for laypeople and citizens to contribute to data collection using this tool. Therefore, to address this issue, we will involve persons with expertise in geographical data for virtual auditing using this tool.

During the data collection, through online forums or on-site social events, we ask participants to provide feedback or exchange information regarding their data collection experiences. The data collection will continue until obtaining the total coverage of the accessibility features in District 1. However, using the above-mentioned web tools, there will still be data gaps in the areas that were not reachable by the vehicle, such as stairs or narrow alleys or where GSVs are missing. Therefore, our virtual data collection will be limited to the areas traversed by the car or covered by GSV images using Infra3D or Project Sidewalk, respectively. To fill this void, the accessibility features will have to be collected via on-site field surveys with the help of research assistants. This can happen by using the most commonly used smartphone apps for enriching and editing OSM data, such as "Vespucci" or "Go Map!!" which enables on-site accessibility data collection. The on-site data collection can also help verify the data derived remotely from virtual audits.

2.4 Discussion and Conclusion

In this project, we aim to contribute to filling the spatial accessibility data gap on sidewalks in Zurich with and for citizens by providing a systematic collection and enrichment of accessibility features utilizing digital tools, and virtual audits. The participatory design of this project involving citizens, researchers, and public partners allows for collecting and enriching a vast amount of detailed accessibility information across a larger geographical area during a shorter period, which not only contributes to considerable savings in time and resources compared to conventional data collection methods but also provides additional descriptive and spatial data to address crucial research and practical questions about the mobility and spatial accessibility of disabled people and how to realize an inclusive urban environment.

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