“I never realized sidewalks were a big deal”: A Case Study of a Community-Driven Sidewalk Audit Using Project Sidewalk

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Figure 1: A community-driven digital civics project using Project Sidewalk, an open-sourced accessibility tool, to conduct sidewalk accessibility assessments in the town of Oradell, NJ. Images show community members mapping, analyzing, and presenting the collected data to the City Council over the course of the project.

ABSTRACT

Despite decades of effort, pedestrian infrastructure in cities continues to be unsafe or inaccessible to people with disabilities. In this paper, we examine the potential of community-driven digital civics to assess sidewalk accessibility through a deployment study of an open-source crowdsourcing tool called Project Sidewalk. We explore Project Sidewalk's potential as a platform for civic learning and service. Specifically, we assess its effectiveness as a tool for community members to learn about human mobility, urban planning, and accessibility advocacy. Our findings demonstrate that community-driven digital civics can support accessibility advocacy and education, raise community awareness, and drive pro-social behavioral change. We also outline key considerations for deploying digital civic tools in future community-led accessibility initiatives.

*Both authors contributed equally to this research.

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CCS CONCEPTS

• **Human-centered computing → Accessibility systems and tools**; **Interactive systems and tools**; • **Information systems → Crowdsourcing**.

KEYWORDS

accessibility, digital civics, community science, service learning, crowdsourcing

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Figure 2: Our 18-month case study was conducted in Oradell, NJ, a small borough 25 miles (40km) outside Manhattan with a population of 8,000 and roughly 40 miles (64km) of city streets. Working with community organizers, we split Oradell into five neighborhood subsections to help geographically distribute work. This figure shows the audit routes, neighborhood names, and street lengths covered in the virtual sidewalk assessment using Project Sidewalk (https://oradell.projectsidewalk.org/).

1 INTRODUCTION

Cities are often designed without adequate consideration for accessibility, creating a myriad of challenges for people with disabilities as they navigate neighborhoods, access buildings, use public transportation, or find accessible housing [23, 28]. Inaccessible design and degraded infrastructure not only limits access to essential services but also affects social participation and mental well-being [3, 24, 32, 50, 73]. To address these issues, many countries have passed legislation mandating that new construction and renovations comply with modern accessibility guidelines [67, 96]. For example, in the US—the site of our case study—the 1990 *Americans with Disabilities Act* (ADA) [69] and the 2010 *ADA Standards for Accessible Design* [68] specify minimum requirements for the accessibility of buildings, public transportation, and sidewalks.

However, despite over three decades of regulatory efforts, most US cities fall short in making their pedestrian infrastructure accessible [22, 23, 31, 41]. This persistent issue can be attributed to multiple factors, including: government funding [22], political willpower [84, 85], community awareness [84, 85], and lack of knowledge among municipal workers [13, 74, 99]. Additionally, there is a lack of reliable, comprehensive, and open information on the accessibility of pedestrian infrastructure [27]. This lack of data has been identified as a key road-block to cities' progress in planning and removing pedestrian infrastructure barriers [22]. Compared to its road counterparts, sidewalk data has no widely accepted standards and very limited funding for collection [22]. Many sidewalk assessments are only started when cities are required to do so under an ADA lawsuit [16].

To collect pedestrian infrastructure data, cities have traditionally employed in-person audits, which are labor intensive and expensive [97], or through citizen call-in reports [70], which are reactive in nature. While mobile applications like *SeeClickFix.com* [12] and *NYC311* [70] have made it easier for citizens to report infrastructure issues, such as damaged or missing curb ramps, these solutions are remedial rather than systemic. They target fixing individual problems rather than fostering community-wide improvements and cultural change.

Emerging crowdsourcing platforms like *Project Sidewalk* [86], *AccessMap* [7], and *WheelMap* [62] provide new potential opportunities for data collection and larger-scale urban accessibility advocacy [33, 56]. While literature concerning social justice and Human-Computer Interaction (HCI) [11, 18, 33, 98, 107] suggests that digital civic tools can be instrumental in effective advocacy, sparse research has been conducted exploring how these new urban accessibility tools have been adopted and used in community advocacy efforts.

In this paper, we provide a longitudinal case study of a community-driven sidewalk advocacy initiative in a small New Jersey community (Figure 2) and examine how they adopted an emerging crowdsourcing tool, called Project Sidewalk [86], to help accomplish their goals. The case study involves an 18-month collaborative effort with local disability advocates, a neighboring hospital, Girl Scout members, city officials, and the Project Sidewalk research team. Through a mixed-methods approach including mapathons, direct observation of advocacy meetings, and post-deployment interviews with key community members (N=19), we examine interactions between stakeholders, the use of Project Sidewalk and other sidewalk auditing methods, and the role of digital civics in pedestrian accessibility advocacy.

Our findings demonstrate (1) how emerging digital tools can aid urban accessibility advocacy and education by facilitating opportunities for engagement across age groups and (2) how participating in these disability-oriented community science activities leads to attitudinal shifts and knowledge gains. In addition, we synthesize (3) key implications for future projects regarding the deployment of digital civic tools and collaboration with communities. Our work contributes to the growing body of digital civics literature [11, 48, 106] specifically related to disability advocacy and the built environment.

2 RELATED WORK

Our work draws on and contributes to research in urban accessibility, community science, and digital civics.

2.1 Accessible Urban Infrastructure

The accessibility of urban infrastructure significantly affects the independence, community participation, and mobility of people with disabilities and older adults. As many as 40.7 million Americans report having a physical impairment impacting everyday tasks [10], and 70% of this population reduce their travel as a result [72]. The

ADA [69] of 1990 was a landmark achievement for the disability rights movement, aiming to eliminate barriers and discrimination in all areas of public life for people with disabilities. However, more than three decades later, people with disabilities continue to face significant barriers in navigating around their communities [16].

The challenge is not only a lack of accessible infrastructure but a lack of data and awareness regarding ADA compliance [5, 22, 47]. In a stratified sample of 178 US cities, Deitz *et al.* [16] found that while 90% of cities published street data, only 34% had data on sidewalks, and even fewer included curb ramps, sidewalk condition, and obstructions. Examining ADA accessibility in US cities, Eisenberg *et al.* [22] found that only 54 of 401 (13%) municipalities had published sidewalk transition plans and only seven met the minimum ADA criteria. In a smaller, independent interview study of government officials, Saha *et al.* identified that cities struggle with sidewalk data collection, community engagement, resource provisioning, and insufficient analysis tools [84, 85]. This lack of data and tools for sidewalks fundamentally limits scientific research in urban mobility and equity, and the ability for communities, advocacy groups, and local governments to understand, discuss, and make informed planning decisions [16].

Previous literature has identified that most local governments are unaware of the extent to which their pedestrian infrastructure is inaccessible [15], and there is a lack of ADA knowledge among municipal workers [13, 74, 99]. Having a comprehensive open dataset on pedestrian infrastructure serves a dual purpose: it is not only the first step in identifying barriers to accessibility for future action, but also promotes transparency and accountability, allowing people to understand their city's priorities and shortcomings and help advocate for change [16, 51, 58].

Despite their high value as a resource, municipal open data are not the only source of information on urban accessibility. Grassroots initiatives like Project Sidewalk [86], AccessMap [7], and WheelMap [62] have made significant strides in collecting data for both ADA compliance assessment and safe routing. Despite these efforts, there has been limited research examining the impact of these emerging crowdsourcing tools. Specifically, questions remain about their effectiveness in supporting communities in accessibility advocacy efforts. We address this gap in our research.

2.2 Community Science

By engaging a broad range of stakeholders in mapping and analyzing sidewalk conditions in a city, Project Sidewalk has become both a digital civics [11, 106] and community science tool [38, 80]. We first provide background on and situate our work within community science before describing relevant digital civics literature.

Community science[1] encompasses a broad spectrum of participatory approaches to scientific research that involve active collaboration between scientists and members of the public [1, 37, 38]. By involving community members in the research process—developing research questions, designing protocols, interpreting data, and disseminating results—community science projects have shown potential to increase public understanding of science [1, 8, 93]. Prior work has also demonstrated that community science can support inquiry-based learning [38] and enhance the relevance and meaning of science to local communities, especially when addressing issues of local concern [42]. Through participation, community members can see themselves as "*valid, competent, and knowledgeable actors*" in the scientific realm [83], breaking down stereotypes that science is"*too complex*" [36]. Community science can also improve an individual's ability to manage information, think critically, make informed decisions [94], and encourage young people to pursue careers in STEM fields [37]. Finally, community science programs can increase communication and connections between academic institutions and communities, enhancing the strength of both groups [17, 81, 109].

Though promising, community science is not without challenges. One drawback is its very reliance on volunteers, which may lead to inconsistent contributions. In studying participant motivations, prior work has identified varied reasons, including the desire to learn, to contribute to efforts larger than oneself, and to meet people with similar interests [76, 77]; however, motivations can shift over time [82]. Additionally, projects often exhibit skewed participation patterns, with a few highly motivated volunteers contributing the majority of the work [25]. In this paper, we reflect on previous research and our own findings to explore how we can design effective participation mechanisms that support community science and engagement.

2.3 Digital Civics

Digital civics, or civic tech, refers to the broad intersection of civics and technology, including mobile applications for civic engagement [63, 66, 71], online platforms for civic debate [46], crowdsourcing open data platforms [88], and sensor-based systems for real-time data collection [45]. Digital civics also extends to technology-mediated offline activities, such as civic workshops [60], civic hackathons [44], town hall gatherings [101], cultural installations [21], and interdisciplinary research labs [29, 61]. For HCI and CSCW (Computer-Supported Cooperative Work) researchers, a traditional focus is to design new tools and platforms that enhance civic participation by improving interactions among people, communities, and organizations [11], such as using street data to facilitate place-based engagement [100] or redesigning voting as a social activity [39, 105].

For individuals with disabilities, civic tech can be particularly beneficial, given barriers to participation in traditional civic engagement due to discriminatory practices, travel limitations, and fatigue [53, 90]. Digital civics presents at least a partial solution: the lack of direct contact between the participant and facilitator in online platforms can reduce biases; the ability to participate from home eliminates the need for travel; and the flexible time commitment allows for accommodation of personal constraints [17, 30]. Additionally, online civic engagement can contribute to community involvement and provide an alternative employment option for people with disabilities [53, 90, 103, 110]. While Project Sidewalk was not originally designed as a community-based civics platform, it was appropriated as such by the Oradell advocacy group.

[1]We use *community science* instead of *citizen science* to describe public participation in science because: (1) *citizen science* may limit widespread and inclusive participation due to its implication of citizenship [89, 104], and (2) *community science* can be interpreted as a type of *citizen science* where the community plays an active role in driving the research agenda [8, 89], which is more reflective of this case study.

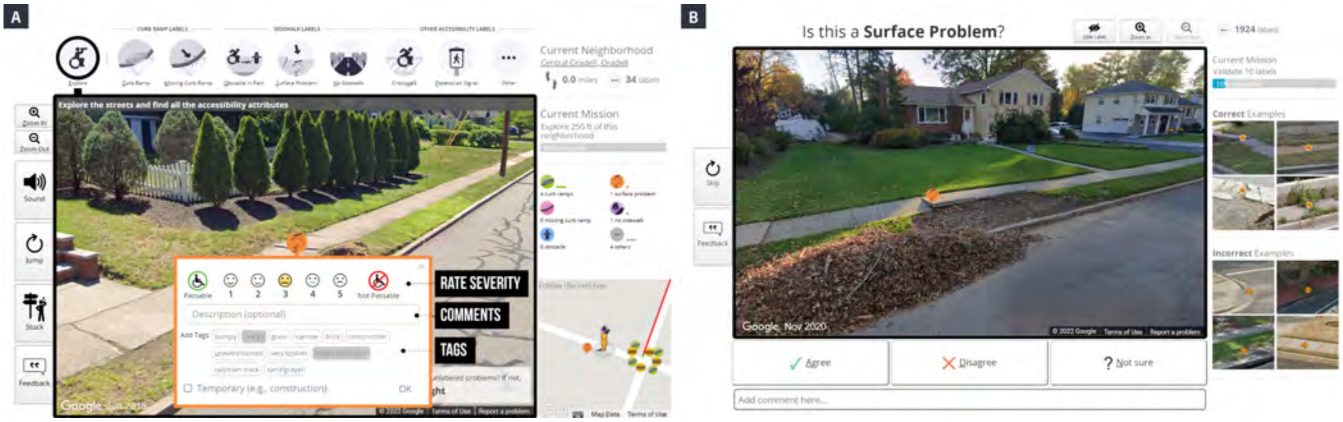

Figure 3: Project Sidewalk screenshots in Oradell, NJ showing two primary missions: (A) An exploration task for locating, assessing, and tagging sidewalk accessibility features and barriers. Here, the user has marked a damaged sidewalk panel with a severity "3" and tagged it with "*cracks*" and "*height difference*". (B) A data validation task for assessing the correctness of previously labeled images by other users. Here, the interface asks "*Is this a Surface Problem?*" and shows a surface problem label placed on a significantly uplifted sidewalk panel. The user should mark "*Agree.*"

3 LONGITUDINAL DEPLOYMENT STUDY

We conducted an 18-month case study, followed by post-deployment data analysis and interviews with key stakeholders. As disability advocacy and digital civics are deeply complex topics intertwining human rights, urban planning, socio-economics, and technology design [84, 85], a mixed-methods longitudinal case study provides the depth, time, and access to examine emergent phenomena, learn from multiple stakeholders, and triangulate across observations [95]. In this section, we first provide context about the Project Sidewalk tool and then discuss the chronology of the community-led sidewalk accessibility project.

3.1 Project Sidewalk

A key focus of our work is exploring how a remote community-science tool like Project Sidewalk can be used to assess urban accessibility and facilitate disability advocacy for the built environment. In this section, we describe Project Sidewalk, including its sidewalk labeling and data validation workflows, gamification and dashboard features, and built-in analytic tools: *LabelMap* and *Gallery*.

3.1.1 Labeling & Validation. Project Sidewalk is an open-source crowdsourcing platform that allows online users to remotely label sidewalk conditions and identify accessibility issues through immersive missions and street view imagery, similar to a first-person video game [86]. The Project Sidewalk workflow includes two primary tasks: (1) an exploration task for locating, assessing, and tagging sidewalk accessibility features and barriers such as *curb ramps* and *surface problems* (Figure 3A) and (2) a data validation task where users are given previously labeled images to assess the correctness by marking *agree*, *disagree*, or *not sure* (Figure 3B).

Project Sidewalk's labeling ontology is based on accessible sidewalk standards [22, 25] and, at the time of our case study, consisted of five primary label types and 35 tags. Label types include *curb ramps*, *missing curb ramps*, *sidewalk obstacles*, *surface problems*, and *missing sidewalks*. When a user places a label, they can assign a severity assessment (on a 1-5 scale, where 5 is the most severe, indicating an impassable barrier for wheelchair users), provide one or more label-specific tags, fill out an optional open-text description, and/or mark a "temporary problem" indicator (for cases such as construction). For example, the label type *obstacle* can be tagged with 14 additional descriptors, including *fire hydrant*, *pole*, *trash can*, and *vegetation*. All labels include additional metadata, such as the street view image date, labeling timestamp, validation information, and geo-location (longitude and latitude).

3.1.2 Features for Sustaining Engagement. To help engage users and provide feedback about performance, Project Sidewalk offers a variety of low- and high-level statistics. During labeling tasks, users can view real-time data about the number and types of sidewalk accessibility features and barriers they have labeled as well as their current accuracy score (based on crowdsourced validations). Additionally, users can navigate to the *Leaderboard* page, which shows top labelers by data contribution and accuracy both overall and for the current week (Figure 4C). Users can also visit their dashboard to see a map of their labels, earned performance badges (*e.g.*, for completing missions or meeting labeling milestones, see Figure 4D), and recent labels that were marked *incorrect* by other users.

3.1.3 Built-in Analytic Tools. Beyond the core sidewalk data collection and validation tasks, Project Sidewalk has a suite of built-in interactive analytic tools designed for disability advocacy groups and urban planners, including *LabelMap* and *Gallery* [20], which allows users to view, filter, and assess patterns in the data. These tools update in real-time as new data is collected and are available from the navigation bar at the top of the Project Sidewalk website.

To identify and analyze spatial patterns in sidewalk accessibility, LabelMap shows an interactive, color-coded map of collected data (Figure 4B). Users can zoom, filter, and toggle information to delve into details and investigate underlying patterns. For example, sliders and toggles allow filtering based on problem type and severity scale

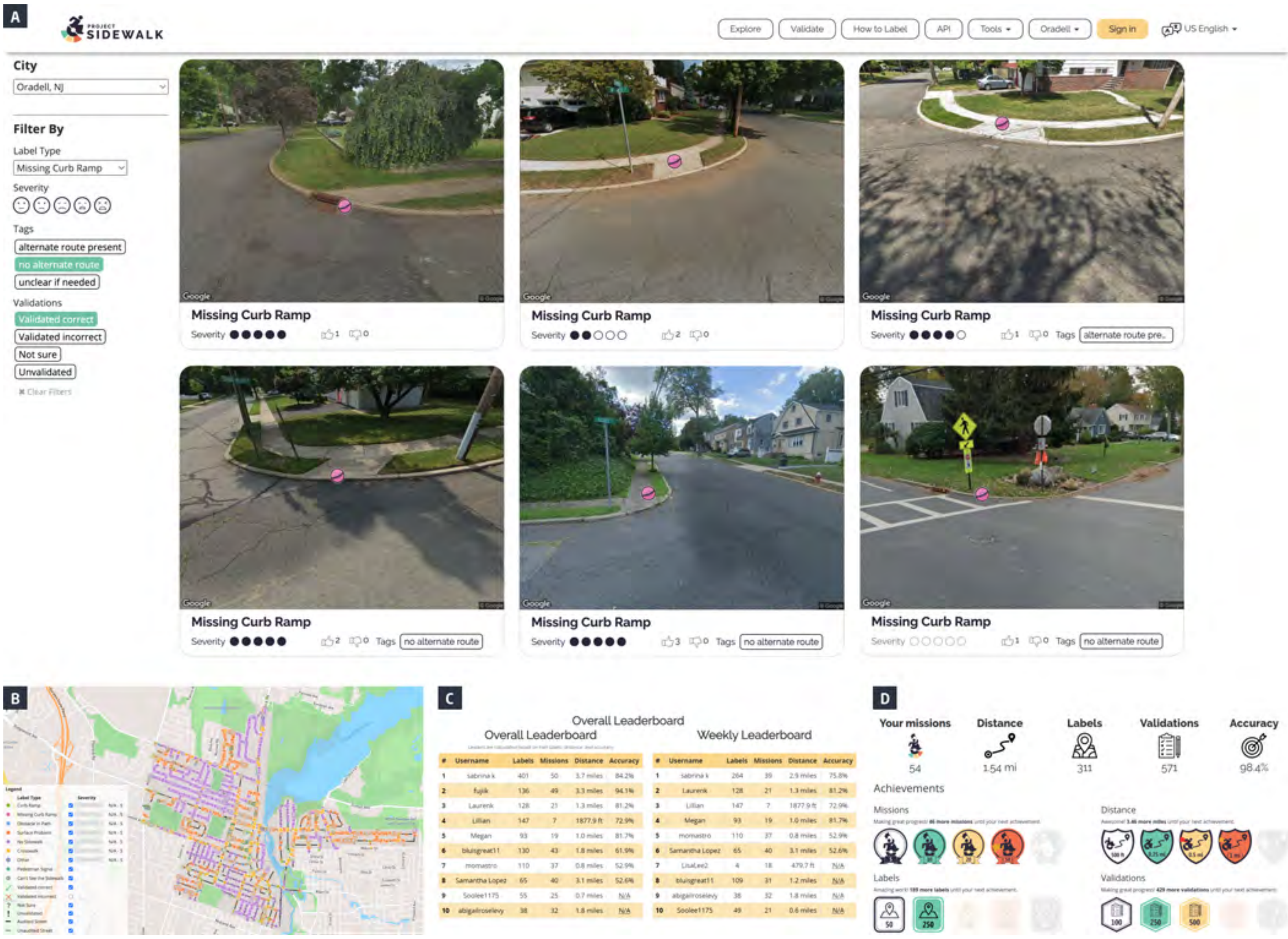

Figure 4: Project Sidewalk contains built-in analytic tools, including: (A) *Gallery* to quickly view, query, and filter images of collected data and (B) *LabelMap* to view and interact with a color-coded map of collected data. Gamification features on Project Sidewalk include a (C) *Leaderboard* page showing top labelers by data contribution and accuracy, and a (D) personal dashboard page showing users’ labeling achievements and earned performance badges for meeting labeling milestones. All screenshots are from the Oradell case study.

(*e.g.*, to support the query “*Where are the most severe surface problems located in the city?*”). Clicking on a label reveals the associated Google Street View (GSV) image and additional metadata, such as image age, label date, and validation information. While LabelMap provides a map-based overview of collected data to reveal patterns of (in)accessibility, Gallery positions the *image* as a first-class object, letting users quickly query, filter, and examine images of sidewalk problems (Figure 4A). Similar to LabelMap, users can explore based on accessibility problem type, severity, and tags. For example, a user can quickly see what all of the most-severe obstacles look like in a city or those tagged with “*slanted*” or “*bumpy*”.

In both LabelMap and Gallery, users can validate data using the same *agree*, *disagree*, and *not sure* choices. This is helpful both for community members and other stakeholders to review collected data in real-time.

3.2 Chronology

We now turn towards our case study of Oradell’s community-driven sidewalk accessibility project—an 18-month collaborative effort involving local advocates, Girl Scout members, city officials, and the Project Sidewalk research team. Below, we provide a chronological account of the project, beginning with in-person sidewalk audits in September 2021 and culminating in a Girl Scout-led presentation to the City Council in January 2023. To aid our descriptions, see the timeline of events (Figure 5) and diagram of interactions between key stakeholders (Figure 6).

3.2.1 Inception. In June 2021, a local advocacy group was formed to identify and improve sidewalks in Oradell for people with disabilities. The group included the local community council of the *National Multiple Sclerosis Society*, representatives from a regional medical organization (*Hackensack University Medical Center* and

Figure 5: Timeline showing dates of partnership formations and key project events in the Oradell Sidewalk Project.

Hackensack Meridian School of Medicine), and a local *Girl Scouts* troop.[2]

3.2.2 In-person Field Audits. In September 2021, the advocacy group and the Scouts held several meetings to generate ideas on how to improve Oradell's urban accessibility for people with disabilities. They first discussed topics such as what constitutes an *"accessibility issue"* and general impressions of Oradell's accessibility levels across neighborhoods, and then decided on conducting in-person field audits to document accessibility barriers. From October to November 2021, advocacy group representatives and the Scouts took photographs of accessibility issues around their neighborhood, including barriers such as missing curb ramps, uneven surfaces, walkway obstructions (*e.g.*, utility poles, overgrown greenery), and obstructed entrances to municipal buildings (*e.g.*, library, post office, town hall). They identified ~30 issues with a location, picture, and description across ~1 miles of sidewalks (Figure 7).

In early November, an advocacy group member (P3 in Table 1) discovered Project Sidewalk online and initiated a meeting to discuss adopting this new approach for identifying accessibility issues. With the Project Sidewalk team's support, they decided to deploy and use this web tool in Oradell (https://oradell.projectsidewalk.org/).

Figure 6: (A) Diagram showing the deeply intertwined interactions between stakeholders in the Oradell Sidewalk Project, including the local medical center (Hackensack Meridian), MS (Multiple Sclerosis) group, and Girl Scouts troop who started the initiative, then engaged with Project Sidewalk and their research team to assess all sidewalks in Oradell, NJ. (B) Image from the initial City Council meeting in March 2022. (C) Image from the first Scouts meeting with local advocates in September 2021.

3.2.3 Assessing Oradell with Project Sidewalk. After obtaining geographic neighborhood boundary data, Project Sidewalk was set up and deployed in Oradell in April 2022. Initial tests and contributions were from the advocacy group and Project Sidewalk team. To broaden community involvement and provide additional training, the organizers planned and held two mapathons and began advertising campaigns within their communities. Figure 9 shows a temporal plot of label and validation contributions over time.

First mapathon. The first mapathon was on April 22, 2022 at the administration building of the local government (Oradall Borough Hall). The event was organized by the local Scout troop leaders, representatives from the National Multiple Sclerosis Society, and students and faculty from Hackensack Medical. The mapathon's goal was to familiarize participants with Project Sidewalk, motivate contributions, and advance understanding of how the built environment can affect people with disabilities.

Figure 7: Examples of sidewalk accessibility issues photographed by advocacy group representatives and Scout members during in-person audits in their neighborhoods.

[2]Girl Scouts is a youth organization for girls in the United States with a mission to "*build girls of courage, confidence, and character, who make the world a better place*" through activities such as camping, community service, and practical skill-building like first aid [87].

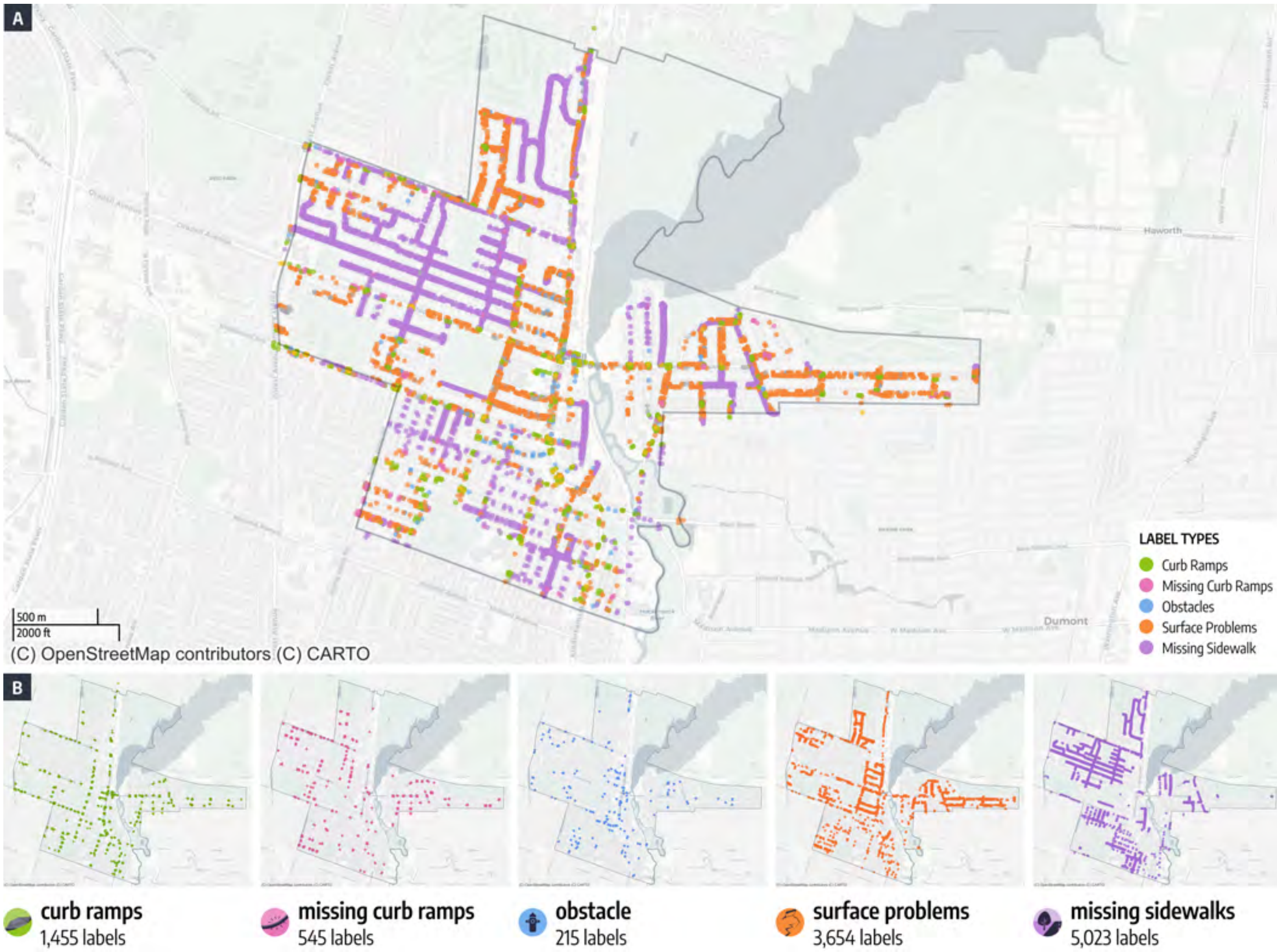

Figure 8: (A) Geographic distribution of all sidewalk assessment labels in Oradell. (B) Geographic distribution of each sidewalk feature label in Oradell. *Surface problems* and *missing sidewalks*, when aggregated, cover almost the entire street grid of Oradell, indicating that *surface problems* are prevalent in places where sidewalks exist.

The Project Sidewalk team joined the event remotely via Zoom to onboard participants and provide support. For training, Project Sidewalk itself begins with a multi-step interactive tutorial to help new users learn the user interface and how to evaluate sidewalk accessibility features and barriers. In Oradell, the average tutorial completion time was 4.6 mins (*SD*=2.3 mins). During the mapathon itself, the Project Sidewalk research team tracked progress and provided live statistics about the fastest and highest quality mappers, along with the number of miles completed and the remaining miles to be mapped. The local organizers provided refreshments and offered T-shirts to the top contributors on the Leaderboard. In total, 20 mappers contributed 2,056 labels and 2,162 validations, covering 21.3 miles (59.33%) of Oradell. At the end of the mapathon, community organizers encouraged participants to continue using Project Sidewalk. In between the two mapathons (from April 23 to August 16, 2022), 34 users continued auditing on their own, contributing 6,131 labels and 7,321 validations.

Second mapathon. On August 17, community advocates organized a second hybrid mapathon. At this stage of the project, all Oradell streets had been audited at least once, so the primary objective was to re-audit areas to ensure high data quality. Unlike the first mapathon, this event occurred primarily online with participants virtually joining from their homes (either together or individually). This approach was feasible due to the online nature of Project Sidewalk, the participants' familiarity with the tool, and the ease of meeting virtually (*vs.* reserving a dedicated space for the mapathon). Again, the Project Sidewalk team joined remotely to help facilitate and answer questions.

3.2.4 Data Analysis. In total, 81 volunteers contributed to the Oradell Project Sidewalk mapping effort, providing 12,191 labels across 35.9 miles of streets, with a total of 19,396 validations and an accuracy rate (calculated by user validation of labels) of 93.1%. Additionally, 85.01% (10,364) of labels were validated at least once

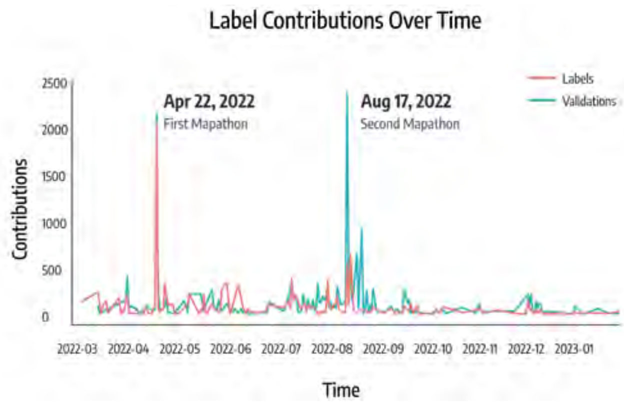

Figure 9: A temporal plot of Project Sidewalk contributions in Oradell from March 2022 to April 2023. Contributions peaked during the first mapathon in April 2022 (2,056 labels and 2,162 validations) and the second mapathon in August 2022 (642 labels and 2,381 validations).

by community members and the research team, and 20.93 miles (58.38%) of Oradell streets received multiple audits.

After collecting and validating the data, the Project Sidewalk research team led an initial round of exploratory data analysis, which included creating spatial visual analytics to understand sidewalk accessibility patterns in Oradell. These initial findings were presented to the community organizers via email and Zoom meetings. Together, using a shared Google Slide deck, new analyses were planned, discussed, implemented, and iterated upon. After a few rounds of iteration with community organizers, Scout troop leaders requested a simplified dataset to use with the Scouts for their own analysis.

Organizer/research team-led analysis. The adult-led analysis—by the research team and community organizers—consisted of evaluating the spatial distribution and frequency of sidewalk features and accessibility problems. To complement this qualitative analysis, the team used Gallery and LabelMap to explore the underlying imagery associated with quantitative trends. Figure 8A shows all the sidewalk labels plotted on a map of Oradell, the colors corresponding to each of the five label types. We can observe two salient patterns: first, there are wide swaths of purple, indicating significant areas of *missing sidewalks*; second, where sidewalks exist, they are often labeled with orange *surface problems*. By combining both purple and orange dots together, a nearly complete road network of Oradell emerges. Overall, we found that 18.8 miles (52.5% of Oradell's streets) lack sidewalks. Despite these identified patterns, not all community members agree that *missing sidewalks* are the most severe problem in Oradell, a point we return to in Section 6.

Compared to other Project Sidewalk deployments in the US, Oradell has an overwhelmingly disproportionate number of *surface problem* labels, 32.4% compared to 15.5% in Seattle and 17.0% in Chicago. From Sidewalk Gallery and an analysis of user-provided tags, the team determined that this was primarily due to significant uplifts caused by tree roots (Figure 12). Of the 5,003 *surface problems* labels, 1,455 (29%) included the *height difference* tag. Interestingly,

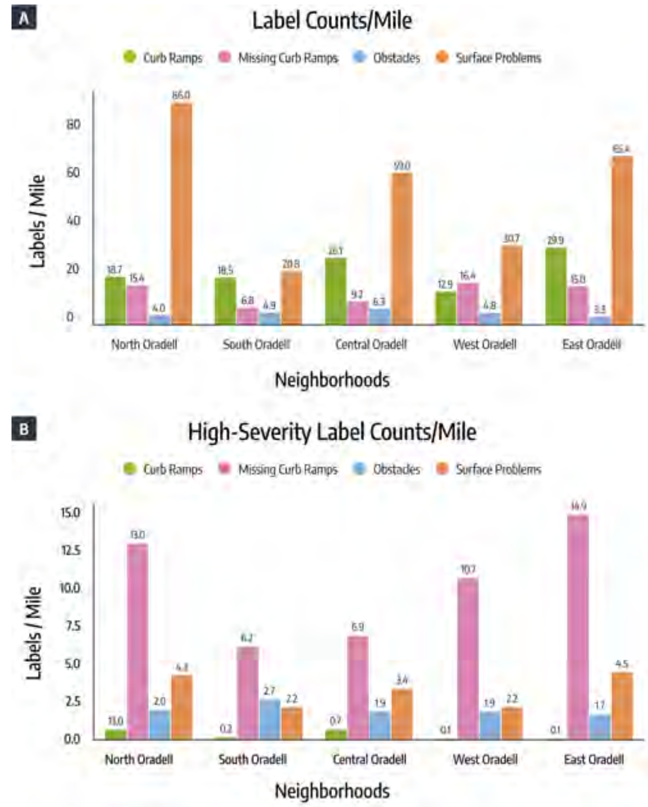

Figure 10: (A) Distribution of label counts per mile indicate that *surface problems* were the most common accessibility issue across all neighborhoods. (B) Distribution of high-severity (severity level 4 or higher) label counts per mile indicate that *missing curb ramps* were the most pressing concern across all neighborhoods.

though far less comprehensive, this also reaffirms findings by the community members' in-person sidewalk audits (Figure 7).

Although *surface problems* are the most common issues in all neighborhoods of Oradell (Figure 10A), they are not necessarily the most severe. When examining labels with severity levels of four or higher, *missing curb ramps* emerge as the most pressing concern, constituting a staggering 71.7% of all high-severity problems (Figure 10B). The absence of curb ramps greatly impedes the mobility of wheelchair users, severely limiting their ability to navigate around town (see Figure 4B). In contrast, we found far fewer high-severity *obstacles* and *curb ramps* (*e.g.* poorly designed ramps) (Figure 11). The high-severity *obstacles* commonly include overgrown vegetation and trash cans, while the high-severity *curb ramps* were pointing towards traffic or had surface issues.

Scout-led Analysis. In discussions with community organizers, they suggested creating a spreadsheet for the Scouts to engage with the data. The research team provided a simplified Excel sheet that included an example bar graph plotting label counts by type, along with guiding questions for further analysis, such as "*Which neighborhoods had the most surface problems?*". In a group data analysis activity (Figure 13), the troop leaders explained the data

Figure 11: Project Sidewalk Oradell labels showing (A) high-severity *obstacles* with poles, overgrown vegetation, and trash cans on sidewalks and (B) high-severity *curb ramps* pointing towards traffic or having surface problems.

Figure 12: Project Sidewalk Oradell *surface problems* labels showing height differences on sidewalks and uplifts caused by tree roots.

analysis goals and connected it to the statistics curriculum they were learning in school. After generating bar charts, the girls were able to find neighborhoods with the most problems and the most severe issues, as well as identifying the most significant sidewalk issue in the community.

3.2.5 Presentation to City Council. After some advocating, the community organizers were allocated a slot to present their findings to City Council. Building upon the Google Slide deck created by community members and the research team, the Scouts worked with troop leaders to develop their own slide deck (see supplementary materials), wrote a script, and rehearsed for the presentation. Then in January 2023, the Girl Scouts presented their findings to Council members. To simplify the advocacy narrative and to help the city prioritize, the Scouts recommended addressing the missing curb ramps as the highest-priority sidewalk accessibility issue in the city. During the presentation, the Girl Scouts delivered their message with clarity, composure, and rehearsed confidence. Members of the City Council commended the Girl Scouts for their work and requested a follow-up meeting to discuss actionable steps for implementing the recommendations.

4 POST DEPLOYMENT INTERVIEWS

To gain insights into this community-driven sidewalk assessment project and the role of an open-source tool like Project Sidewalk therein, we conducted post-deployment interviews with key stakeholders and Scout members. Specifically, our research questions include:

RQ1: How can emerging tools like Project Sidewalk be used to support urban accessibility advocacy?

RQ2: Through their participation, what did key stakeholders—from the Scouts to community members—learn about sidewalks and disability, urban planning, and accessibility advocacy?

4.1 Methodology

We conducted two types of semi-structured interviews: a group interview with ten Girl Scout members and individual interviews with nine additional participants. For both types, we asked questions about motivations for participating, perceptions of urban accessibility and disability, collaborations with partners, perceived project outcomes, and overall experience. For the Scouts specifically, we also asked about their experiences conducting in-person audits versus using Project Sidewalk, their data analysis experience, and their presentation to the City Council. All sessions were conducted remotely by the primary researchers. Prior to beginning the interview, participants provided informed consent. Each interview session lasted approximately one hour, and participants were given US$20 gift cards as compensation.

4.2 Participants

In Table 1, we list the ten Scout members and nine community members who participated in the interviews, each of whom played a key role in the project. These include disability advocates, wheelchair users, local healthcare professionals and medical students, Scout troop leaders, Scouts’ parents, and other community members. Interviewees were recruited through email invitations and word-of-mouth. To preserve anonymity, we refer to the Girl Scouts using the identifier “GS” and other participants using the identifier “P” followed by their participant number.

4.3 Analysis Methods

We audio and video recorded the interviews and thematically analyzed the data through a combination of deductive and inductive coding [9]. To prepare for the analysis, the research group established an initial codebook based on the interview protocol. Two primary researchers then engaged in an iterative process of coding and peer checking [14, 52, 64] to ensure the reliability and validity of the analysis. The first coded an initial transcript using the codebook, which was reviewed by the second. Both researchers then discussed and resolved any disagreements, updating the codebook and previously applied codes accordingly. Next, the first primary researcher coded additional transcripts, and the second spot-checked one of the transcripts. They then repeated the process of resolving disagreements, updating the codebook, and re-applying codes. Finally, the first researcher completed the remaining analysis using the updated codebook (Table 2).

5 FINDINGS

Below, we describe three categories of findings: (1) changes in participants’ attitudes, behaviors, and awareness towards human

#	Project Role(s)	Primary Contributions	Additional Notes
GS1-10	Girl Scouts	Contributed to labeling, performed data analysis, prepared presentation, delivered analysis findings to City Council	Ages 11-12
P1	Overall Coordinator	Oversaw entire project, obtained permission from town, partnered with the Scouts, shared personal stories about living with a disability	Wheelchair user, disability advocate
P2	Project Initiator	Documented sidewalk obstructions through photos, sparked interest in starting the project	Neurologist, educator, disability advocate
P3	Medical Student Leader	Helped initiate Project Sidewalk involvement, became highest data contributor with over 3,000 labels & 8,000 validations	Medical student, wheelchair user
P4	Event Organizer	Organized mapathons, provided venues and refreshments, engaged community members	Healthcare professional, has a disability
P5-7	Troop Leaders	Organized mapathons and meetings with advocacy members and City Council, guided Scouts with data analysis	Scout parents
P8-9	Community Volunteer	Contributed labels & validations during mapathons	Neighbor, friends of P1

Table 1: Participants' information, roles, and main contribution to the project

mobility, disability, and urban design (RQ2); (2) enhanced civic engagement (RQ2); and (3) the role of digital civics in urban assessment (RQ1). Participant quotes have been slightly modified for concision, grammar, and anonymity.

5.1 Attitude, Behavior, & Awareness Changes

From the interviews, we identified attitudinal and behavioral changes in participants, especially the Scouts, and noted an increase in their awareness of civic responsibility and social advocacy.

5.1.1 Perceptual & Behavioral Changes Towards Urban Accessibility. Scout members initially perceived Oradell as accessible, but their perceptions changed as they engaged with the project. As GS3 stated: *"Initially, I thought Oradell was a pretty safe place for people with disabilities. [. . .] But once we started doing research and taking pictures of the inaccessible places around town, I realized that the town is not very accessible."* This awareness-raising extended to other volunteers as well: *"[Being a part of this project] really opened my eyes. Like who would have thought that not returning a shopping cart could be such a big problem for someone in a wheelchair? It was definitely eye-opening and a good learning experience for all of us"* (P4, healthcare professional).

In addition to physically and virtually assessing sidewalks, the close interactions between participants and community members with disabilities (*e.g.* P1 and P3) also enriched the community's understanding in two significant ways. First, it allowed them to view urban accessibility from the perspective of disabled people. For example, G4 shared: *"Before Project Sidewalk, I never realized how important curb ramps are for people with disabilities. I used to think that lifted-up sidewalks were the biggest issue because that's what I saw the most and could relate to. But seeing everybody's experience really helped; then I knew missing curb ramps were the biggest problem"* (GS4). Second, these personal interactions helped the community adopt a critical mindset to assess urban infrastructure and contribute more accurately to the Oradell Project Sidewalk dataset. Notably, the Scouts routinely consulted wheelchair users during the mapping process, including questions like *"Is this a problem for you?"*, *"Do you struggle with this part of the sidewalk?"*, and *"When you reach a point where a sidewalk has been pushed up by a tree, what do you do?"* As GS3 reflected : *"There was a bunch of people who we personally got to meet who had disabilities, and we got to learn about [their lives] and see how they get around town. That was like a really special moment for me."*

Beyond awareness, the project had a tangible impact on the Scouts' everyday behavior—assessing the built environment for accessibility as they engaged with it. P1 commented, *"Now when they walk down the street and see something [that is not accessible], they quickly notice and say 'This is wrong!'"* Similarly, troop leader and parent P5 shared: *"I was driving a few Scouts home and one stopped to point out that a sidewalk was falling apart and said 'we need to make sure that gets labeled [on Project Sidewalk]!'"*

The Scouts also appreciated learning about urban design, human mobility, and disability—pointing out a lack of previous exposure in formal education. As GS5 remarked, *"Schools don't teach enough about disabilities."* The Scouts gained an understanding of terminology as well as how inaccessible environmental features affect mobility. *"Before we did Project Sidewalk, I had no clue what a missing curb ramp was, what a surface problem was. . . "* (GS3). Similarly, GS7 said: *"One thing that I really liked about the program is that it gave everyone new information. . . it educated us. And now we have better and stronger background information, and something that we could build off of in our life."*

5.1.2 Raised Awareness of Civic Responsibility. Through their participation, the Scouts developed a stronger sense of civic responsibility, a broader awareness of the challenges facing their community, and their role in effecting positive change. As GS3 noted, *"It didn't feel like we were doing it for ourselves. We did it because we wanted*

	Major themes	Description
T1	Learning about disability	What did the Scouts learn about disability from this project? What attitudes, beliefs, and understandings changed as a result? (Describe what and how they learned before and after the project.)
T2	Learning about urban accessibility	What did the Scouts learn about accessibility from this project? What attitudes, beliefs and understandings changed as a result? (Describe what and how they learned before and after the project.)
T3	Civic skills and participation	What civic skills did Scouts gain from the project? (Describe the civic skill acquisition from the project.)
T4	Science learning	What did the Scouts learn about science from the project? (Describe the scientific skills they learned from the project.)
T5	Full pipeline /events	How did the continuous "full-pipeline" nature, *i.e.* each phase of this project influence participants' engagement and outcomes?
T6	Policy change	What outcomes were achieved and challenges faced in this project with respect to influencing real policy change?
T7	Advocacy practices	What practices and considerations were used to deliver successful advocacy outcomes throughout this project?
T8	Participant roles	What roles did each participant play in the process, and how did that contribute to project success?
T9	Digital tool	What were the participants' perceptions and experiences of using the Project Sidewalk tool?

Table 2: Major themes and descriptions from codebook.

to help others, and it's fulfilling to know that we made a difference." This sentiment was echoed by others, who expressed a desire to contribute to their community and help those in need. As GS2 explained, *"Our goal wasn't just to fix sidewalks, but to address every obstacle that stood in the way of making our community a better place."* GS9 added *"I enjoyed being included in a change."* Such quotes reveal a sense of empowerment and agency in the Scouts' ability to positively change their communities. As GS7 said, *"[this experience] gave me a new perspective that I can use to help change the world."*

5.2 Civic Engagement

While the above section focused on changes in attitude, behavior, and awareness, here we focus on scientific- and civic-related skill development amongst participants. We describe four primary areas: scientific inquiry and data analysis, storytelling and public speaking, understanding real-world constraints, and collaborative interactions in civic engagement.

5.2.1 Scientific Inquiry & Data Analysis. As key drivers of the project from the onset, the Scouts were uniquely engaged in the full scientific inquiry process, including observation, problem identification, hypothesis generation, data collection, analysis, and drawing conclusions.

Problem identification. Before the Oradell Sidewalk Project, Scout leaders (P5-P7) had traditionally selected projects for the troop. In 2021, when the Scouts reached sixth grade, the leaders felt it was time for them to choose their own projects. To facilitate this transition, they invited P1, a guest speaker who discussed sidewalk accessibility based on his personal experience. Inspired by P1, the Scouts opted to advocate for more accessible sidewalks in their community. Upon reflection, the scout leaders found that the retention rate for this project was higher compared to others, largely because the Scouts were personally invested in the project. This example highlights the importance of empowering young volunteers in civic engagement by allowing them to identify issues on their own and select projects that genuinely resonate with them.

Data collection. During the group interview, the Scouts were able to critically reflect on the different methods of data collection, such as in-person audits and online mapping with Project Sidewalk. GS6 said: *"When we're using the app, we can go really fast and collect data more efficiently. When we're walking, we can see more detail, like everything on the path, but it just might be harder to collect all that data."* GS4 said: *"On the computer we can map a lot of Oradell, and we were working together to map each specific road."* GS3: *"If there was a divot in the sidewalk, when you're online it looks flat and you would assume that it's bad and mark it, but in person, you could see it up close, it might just be a small bit of the sidewalk chipped off and not that much of a problem."* GS7 added: *"There were also temporary obstacles on the road we saw on the screen like garbage cans, they could all change [. . .] going on a physical walk gave me a better understanding of people's actions that block off paths."*

While there were occasions where the Scouts mislabeled sidewalks, troop leaders suggested that these mistakes offered valuable opportunities to learn about data validity and reliability. As one troop leader and parent (P5) said, *"It gave them an appreciation for paying attention to detail and understanding what this term reliability means, . . . what kind of checks and balances to have on your data was an interesting lesson learned."*

Analysis and drawing conclusions. The Scout troop leaders and the research team collaborated to determine an appropriate way for the Scouts to analyze and interpret the data. In the end, they decided to simplify the dataset into an Excel sheet, enabling the Scouts to engage in a hands-on activity (Figure 13). Per P5 (a troop leader and parent): *"We had them create tables and histograms based on the issue they found. And from their (the Scouts) analyses, they were able to say 'Based on this, we see that the greatest barrier here in Oradell is missing curb ramps.'"*

Besides the most severe sidewalk problem in Oradell, the girls also came to conclusions that countered their previous assumptions. As P5 (a troop leader and parent) described: *"They were all expecting the center of town to be least accessible and have the worst sidewalks, [. . .] that was the part of town they most frequented, and P1's story of being unable to access a restaurant there really stuck with them."* While personal narratives like P1's can be powerful motivators in providing context, they are inherently subjective and may not always align with empirical data. This was a valuable experience for the Scouts in balancing anecdotal evidence with objective data, enhancing their understanding of research methodology.

5.2.2 Storytelling & Public Speaking. To prepare their presentation to the City Council, the Scouts worked to translate their analytic findings into stories and key takeaways, sought feedback on early drafts from key stakeholders, and rehearsed and polished their speaking script. GS2 stated that *"convincing the City Council"* was a major obstacle, since they had to craft a compelling narrative to communicate *"what the problems were"* and *"why"* they mattered.

Several Scouts expressed apprehension and nervousness about speaking in front of others. GS9 noted that *"The biggest challenge was talking to the City Council. [. . .] and that was a lot for me, but also taking that step towards change."* GS5 shared that *"At first I was really nervous. Then I realized it was nerve-racking because it was something that can make such a big difference and would really change a lot of people for the better."*

Troop and project leaders both noted the impressive growth that the Scouts demonstrated in their public speaking abilities. The troop leader (P5) remarked, *"I would say that not all of these girls are public speakers. But they all knocked it out of the park."* Similarly, P1 highlighted the significance of the Scouts' achievement: *"The fact that they've learned how to speak to a government body, that's not a small thing."*

5.2.3 Understanding Real-world Constraints. Preparing for and speaking to the City Council also provided the Scouts with a deeper understanding of real-world political constraints, the challenges associated with implementing social change, and the complexities of fundraising. After the presentation, members of the City Council commended the Scouts for their work and requested a follow-up meeting to discuss the next steps. However, at the time of our interviews, more than a month had passed since the presentation, and there had been no updates from the City Council. Though frustrated by this lack of urgency, they were also able to recognize that *"real world changes take time,"* as noted by P5. The Scouts also learned about how policy change and financial constraints intersect: *"We need to find out how we can get funding to fix missing curb ramps in our town"* (GS6).

5.2.4 Identities, Roles, & Collaborative Interactions in Civic Engagement. When reflecting on the success of the project, all participants emphasized the twofold importance of ***which*** groups contributed and ***how*** they collaborated. The project would not have been possible without the collaborative efforts of community members and local disability advocacy groups—and their long-lived roles in the community—as well as the Scout troops and Project Sidewalk research team. As P2 summarized, *"If it hadn't been P3 reaching out to the research team, P4 getting us to match her drum beat, P1's 20 years of residency in a small town where he knew everyone, including the mayor and City Council representatives [. . .] and that he learned how to engage with communities through his MBA [. . .], the project would have not happened."* P4 also commented that *"I think P1 is a goal-getter and can get things done and he's not afraid to ask for things. I think P3 was the brainstorm to it all. P5 was an educator by trait, and she built this whole educational piece, which I could never have done."*

The Scouts also recognized the significance of working together towards a common goal, as expressed by GS4: *"If we start taking actions [. . .], we can raise awareness about accessibility issues. Obviously, we cannot fix everything with just one person or one troop. It needs to be a group effort with everyone involved."* They also highlighted the importance of having a person with a disability involved in the project. As stated by GS7, *"For our troop, hearing P1's stories really made us feel connected to the project and motivated us to learn more."*

5.3 The Role of Digital Civics

For our final findings subsection, we reflect on how the remote sidewalk assessment tool—Project Sidewalk—helped support education and facilitate advocacy, and we enumerate participant-identified strengths and weaknesses.

5.3.1 Benefits & Limitations of Using Project Sidewalk. Community organizers began their sidewalk assessment efforts with in-person audits in October to November 2021 before reaching out to the Project Sidewalk team. As community organizers realized the time and effort required to audit the entirety of Oradell in-person, they

Figure 13: (A): Scout members conducting data analysis together, with assistance provided by troop leaders. (B): Scout members presenting findings of the analysis to the local City Council, which was broadcasted on Oradell Public Television.

began researching alternative approaches. The efficiency of Project Sidewalk was cited as a primary benefit. As P1 explained, *"Originally we were gonna have them [the Scouts] just walk around town, and that also would require a lot more time. [...] It was [Project Sidewalk] that took a project that was beginning to look non-scalable and made it scalable."* P3 also preferred *"the virtual approach"* compared to in-person audits: *"It is amazing to think that in just a few hours of auditing the streets, users can label multiple problematic sidewalks and validate others' work, which is difficult to do in person."*

In addition to scalability, the ability to remotely participate with Project Sidewalk was beneficial, facilitating greater accessibility and inclusivity. Several participants noted that it was much easier for them to engage from their homes, including P3, who said, *"It allows users to contribute from the comfort of their homes, as long as they have access to the Internet."* Others mentioned that remote participation was particularly beneficial during the pandemic, stating that *"this [Project Sidewalk] was great [...] in this COVID world, the students can't go out, so it's good being safe at home"* (P4).

As for Project Sidewalk limitations, participants emphasized two main points: (1) outdated GSV images affecting the usefulness of the data collected and (2) the limited accessibility of the tool to people with upper-body motor disabilities and blind or low-vision users. Of the 12,076 labeled GSV panoramas in Oradell, the average image age was 3.1 years (*SD=2.2 years*). P8 noted that once she realized how outdated some of the images were, she lost some momentum. Towards Project Sidewalk's UI accessibility, both the labeling and validation missions are inherently visual search tasks requiring users to examine streetscape imagery and then to find, assess, and label sidewalk features and problems. Moreover, the labeling missions themselves require significant user interface interactions: panning, zooming, and clicking, which can be difficult for people with upper-body motor disabilities or who use alternative input devices like voice input. P1, who is a wheelchair user and uses speech input for desktop computing, shared that *"Personally, I found it difficult to keep going due to the nature of my disability, and I imagine someone who is blind would have a hard time using it."*

5.3.2 Sustaining Engagement. A key challenge in digital civics projects is sustaining engagement. From our interviews, we identified three key motivators for continuing the work: a sense of empowerment and accomplishment, socialization amongst community members and friends, and overall enjoyment. In terms of enjoyment and fun, participants felt that they were working on an important topic worthy of their time and were making progress. For some, the gamification mechanisms, such as stats tracking and the leaderboard were motivating, especially for younger participants. As P4 expressed, *"My son is a big gamer...After he completed the task, he made it onto the Leaderboard and [felt so good!]"* Similarly, GS3 said: *"As we were mapping, [we saw] who was the top mapper and how many miles we had covered so far. It was exciting to see that we had mapped a significant portion of Oradell [...] and to know how much we had accomplished together."*

5.3.3 Support in Training, Interpreting, Visualizing Data. Effective use of digital civic tools requires not only a well-designed platform, but also comprehensive tutorials, technical support, and guidance to help community members interpret and visualize the data. The research team recognized the need for training and support for participants, and thus provided virtual onboarding during mapathons and technical assistance throughout the project—which took significant time and effort. GS4 highlighted the importance of this support, saying, *"Having [research team member] there to guide us through the program, along with our troop leaders, was very important. We wouldn't have known how to label all the problems we found without their help."* P2 mentioned that the research team member provided coaching online with *"infectious charisma and enthusiasm."*

To help participants translate the data into meaningful findings, the Project Sidewalk team also scaffolded the Scout's data analysis. P5 commented that *"Funneling that data back to us was very important; that is why action research matters."* In addition, she said the project was special because her Scout members generated the data themselves, which is more meaningful than just being given a dataset to analyze. She would often remind the Scouts that *"every count you see is something that we input into the system,"* emphasizing the importance of their active participation.

The easy-to-use nature of Project Sidewalk was also emphasized. As P2 noted, *"The beauty of this software is that even a child can use it. We [the adults] went through validation to ensure the accuracy of the data, but the fact that 12 to 14-year-old children can produce actionable data is extremely meaningful."* This underscores the importance of creating tools that are both accessible and empowering, allowing people of all ages and backgrounds to engage in civic action to make a lasting impact in their communities.

6 DISCUSSION

In this paper, we examined a community-led sidewalk accessibility effort in a New Jersey suburb, the ways in which emerging tools were adopted to support that effort, and how stakeholders worked together to accomplish their goals. Our findings revealed attitudinal and behavioral changes in participants regarding urban accessibility, increased awareness for civic engagement, and insights into the role of digital civic tools in community advocacy. While ongoing, the project is officially recognized by Oradell city officials, and there are plans to expand to other Bergen County regions. We now situate our findings in related work, and discuss the more critical themes emerging from our analysis, including tensions between community science and service learning, as well as implications for conducting future research.

6.1 Community Science & Learning Tensions

Inherent tensions may arise between scientific endeavors, which are pursued to discover and communicate knowledge, and service learning endeavors in the civics realm, which focus on education, community contributions, and learning outcomes [80, 91]. These conflicting objectives may complicate efforts to engage and teach participants while generating high-quality data [78, 91, 92, 108]. The Oradell Sidewalk Project adopted various measures to mitigate such tensions. To enhance the learning process, disability advocates shared their personal experiences with the Scouts, which motivated them to learn more about urban accessibility and established a deeper connection with the project. To ensure accuracy, the research team collaborated with advocacy and troop leaders to develop comprehensive and appealing training materials, along with onboarding sessions to ensure participants shared a common vision and understood how to use the tool. During mapathons, organizers invited residents with mobility disabilities to assist the Scouts in accurately labeling sidewalks. In addition, Project Sidewalk's built-in validation tools and user-sustaining strategies contributed to maintaining high-quality data while keeping the process engaging and conducive to learning. While previous work supported such strategies [91, 102], some scholars have pointed out the trade-off between dedicating resources and time to create engaging activities and achieving the scientific and educational goals of a project [49].

Prior research has also identified tensions between participants' engagement in a scientific process versus doing the practical requirements of the project, such as required training and the necessary labor (*e.g.*, data collection [54, 80]). For example, Moss *et al.* [65] found that students who are collecting data for scientists lacked a sense of project ownership and felt frustrated with the repetitive nature of their tasks. The Oradell Sidewalk Project strove to enhance the Scouts' agency by actively involving them in decision-making. Previously, Scout service-learning projects were determined by the troop leaders; however, for this project, the leaders believed that the Scouts were sufficiently mature to select their own initiative. Following a meeting with advocacy leaders, the Scouts decided to undertake the sidewalk initiative. Upon completion of the data collection phase, the Project Sidewalk team provided initial analysis materials, but let the Scouts and community advocates interpret the findings and decide on what to present to the City Council.

Many community science projects aim not only to advance scientific knowledge, but also to share knowledge with the community at large. In general, projects adopt either a two-way approach that emphasizes participatory dialogue [35, 59] or a one-way approach focused on outreach and dissemination [80]. Traditional one-way dissemination can generate significant tension in a learning environment, where science is perceived as the absolute truth and the scientific method as the only way to produce reliable knowledge [34, 80]. This reinforces power imbalances between scientists and community members, where scientists are seen as the owners of knowledge and community members as passive recipients of information. In contrast, a two-way participatory approach bridges the gap between science education and science communication by positioning science as one type of knowledge, and the scientific method as one of many ways to describe the world [2]. The Oradell Sidewalk Project adopted a two-way participatory approach, involving the Scouts in the entire scientific inquiry process, from observation and problem identification to hypothesis generation, data collection, analysis, and drawing conclusions. By involving participants in this way, community science empowers communities in gathering data, articulating pressing issues, advocating for their own local environments, while at the same time feeling ownership over the science based decisions that were made. In addition, the two-way participatory approach was reflected in the involvement of the disabled community members. While lived experiences have not been traditionally considered as scientific, emerging research has increasingly recognized their value [4, 40, 57]. The significant involvement of people with disabilities in our project further demonstrates how their perspectives can contribute to democratizing the problematic imbalances in community science projects.

Another tension arises from the different evaluation criteria used in community science and service learning. While community science focuses on the capacity of science for activism, education prioritizes the achievement of specific learning objectives [34]. Informal environments can make it difficult to capture the learning outcomes of community science projects [34]. In our work, we used qualitative methods such as interviews and observation to identify key findings; future work should consider examining individual learning outcomes (*e.g.*, using Phillips *et al.*'s framework [75]).

6.2 Implications for Future Projects

In subsection 5.3, we began to enumerate the role of digital civics in community-led sidewalk assessment projects. Here, we further summarize recommendations for community science projects attempting to drive local advocacy.

Respecting community choices. During the research team's initial analysis of the mapping data, we identified a severe lack of sidewalks in Oradell. However, community members questioned the need for ubiquitous sidewalks in their town, where many streets are *"small, dead-end streets with only six houses"* (P1). Previous work in community science suggests that researchers should adopt a facilitator role rather than a sacrosanct all-knowing one [80]. While researchers can assist the community in analyzing data, it is ultimately up to the community to interpret and act on it in ways that reflect their values. Similarly, communities may employ different methods to assess sidewalks, ranging from top-down engineering approaches (*e.g.*, LiDAR-based surveying [43, 55]), which provide high-quality 3D reconstruction data but limited community engagement, to community-driven approaches that prioritize local needs and lived experiences. Choosing the "right" approach is dependent on the community's goals and its available resources.

Developing meaningful, longitudinal, and tangible projects. Participation and retention in community science and digital civic projects can be enhanced by creating projects that are meaningful, longitudinal, and tangible [26]. According to P1, this sidewalk initiative was more tangible than previous advocacy efforts since it generated actionable recommendations for decision-makers. Moreover, troop leaders ascribed the meaningful purpose and longitudinal nature of the project as cause for the unusually high retention rate for troop member participation. Unlike past projects, the Oradell Sidewalk Project seemed to sustain the Scouts' engagement, focus, and energy: *"It has become a part of their identity"* (P5).

Shifting the evaluation criteria. Scholars increasingly call for community science projects to be evaluated not just based on scientific input and data quality, but on participant experience and societal impact [79, 80, 91]. Though other Project Sidewalk deployment cities have similar labeler accuracy and speed, Oradell stands out due to its more comprehensive outreach, closer collaboration with local partners, and wider societal impact. Future community science projects should look beyond data quality as a mere computational parameter, and evaluate the overall qualitative process and the project's effects on the local community and attitudinal and behavioral shifts.

6.3 Limitations

Our case study has three primary limitations. First, we conducted our work in an affluent suburb of New Jersey (median household income of $174,643[3]). As noted in prior work, community science projects have historically served affluent populations [6, 19], and findings from such projects may not be representative of other communities. Moreover, as mentioned by our participants, in low-income communities, access to the necessary resources for contributing to Project Sidewalk, such as a laptop, mouse, and Internet connection, may be a challenge. Second, as an image-based labeling tool that requires visual search to label, Project Sidewalk is not accessible to people who are blind or low-vision, which may exclude participation. Additionally, its heavy reliance on panning, zooming, and clicking interactions can exclude participants with upper-body motor disabilities or who use alternative input devices. Finally, the complexity of our project in terms of people, communication, and technology may make it challenging to replicate in the future. This project's success hinged not just on technology tools, but on the longitudinal engagement of a diverse group of participants, including community advocates, Scout members, educators, healthcare professionals, city officials, and the research team. Such an extensive collaboration requires resources, time, expertise, and sustained collective will.

7 CONCLUSION

In conclusion, our work highlights the opportunity for community-driven urban accessibility using emerging civic participation tools and the potential for these tools to be used in service learning to advance understanding of urban design, disability, and human mobility. Disability advocacy is complex, and digital civic tools play but one role. Our work helps highlight that even if there is no immediate impact on governmental policy, the use of these tools serve as educational and advocacy vehicles that can drive community action and cultural shifts.

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