

MIT Open Access Articles

The Future of Urban Accessibility: The Role of AI

The MIT Faculty has made this article openly available. **Please share** how this access benefits you. Your story matters.

Citation: Froehlich, Jon, Li, Chu, Hosseini, Maryam, Miranda, Fabio, Sevtsuk, Andres et al. 2024. "The Future of Urban Accessibility: The Role of AI."

As Published: <https://doi.org/10.1145/3663548.3688550>

Publisher: ACM|The 26th International ACM SIGACCESS Conference on Computers and Accessibility

Persistent URL: <https://hdl.handle.net/1721.1/157612>

Version: Final published version: final published article, as it appeared in a journal, conference proceedings, or other formally published context

Terms of use: Creative Commons Attribution



The Future of Urban Accessibility: The Role of AI

Jon E. Froehlich
Allen School of Computer Science
University of Washington, USA
jonf@cs.uw.edu

Chu Li
Allen School of Computer Science
University of Washington, USA
chuchuli@cs.uw.edu

Maryam Hosseini
City and Regional Planning
UC Berkeley, USA
maryamh@berkeley.edu

Fabio Miranda
Department of Computer Science
University of Illinois Chicago, USA
fabiom@uic.edu

Andres Sevtsuk
City Form Lab, Massachusetts
Institute of Technology, USA
asevtsuk@mit.edu

Yochai Eisenberg
Disability and Human Development
University of Illinois at Chicago, USA
yeisen2@uic.edu

Abstract

We have entered a new era of computing—one where AI permeates every aspect of society from education to healthcare. In this workshop, we examine the emerging role of AI in the design of equitable and accessible cities, transportation systems, and interactive tools for mapping and navigation. We will solicit short papers around key Urban AI + disability themes, including autonomous vehicles, intelligent wheelchairs, assistive human-robotic interaction, assessing and navigating pedestrian pathways, indoor accessibility, and overarching challenges related to ethics, bias, and data privacy and security. We invite both traditional HCI and accessibility researchers as well as scholars and practitioners from other disciplines relevant to this workshop, including disability studies, gerontology, social work, community psychology, and law. Our overarching goal is to identify open challenges, share current work across disciplines, and spur new collaborations related to AI and urban accessibility.

CCS Concepts

• **Human-centered computing** → **Accessibility systems and tools**; **Visualization systems and tools**; • **Applied computing** → *Law*; *Cartography*; *E-government*.

Keywords

Urban accessibility, smart cities, urban AI, human mobility, built environment, autonomous vehicles, sidewalks

ACM Reference Format:

Jon E. Froehlich, Chu Li, Maryam Hosseini, Fabio Miranda, Andres Sevtsuk, and Yochai Eisenberg. 2024. The Future of Urban Accessibility: The Role of AI. In *The 26th International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS '24)*, October 27–30, 2024, St. John's, NL, Canada. ACM, New York, NY, USA, 6 pages. <https://doi.org/10.1145/3663548.3688550>

1 Introduction

How will AI transform urban infrastructure for people with disabilities—from public transportation and sidewalks to the design and

use of buildings, housing, parks, and transit stations? What new mobility tools and techniques will AI enable, from autonomous vehicles and micro-mobility solutions to personalized routing and accessible interactive maps? How can AI be used to effectively and ethically solve urban accessibility problems and improve the quality of life for all? How can and should people with disabilities be involved with decisions about how AI is used in cities? In this workshop, we will bring together researchers, disability advocates, and policymakers to discuss the future of urban accessibility and the role of AI therein.

These cross-disciplinary conversations are critically important. In a recent review of 83 smart cities publications spanning computer science, rehabilitation medicine, and urban studies, Zhou *et al.* [67] found that “*people with disabilities are rarely considered*” and that few studies adopt an inclusive sociotechnical perspective to design “*human-centered smart cities*.” HCI is not immune to such criticism either. In a recent HCI workshop formulating an agenda for interdisciplinary research on “Urban AI” [37], disability and inclusivity are not mentioned—though other important and intersectional topics are, including environmental sustainability, public health, ethics, privacy and surveillance, citizen science, and participatory design.

Recognizing AI’s potential in the future of urban design and human mobility but the lack of emphasis on inclusivity and involvement of people with disabilities, disability advocates have launched campaigns such as *Cities4All*¹ and *SmartCities4All*² that align key commitments of city governments to universal design, the *Convention on the Rights of Persons with Disabilities* [45], and the *UN Sustainable Development Goals* [44]. For example, as part of *Cities4All* and *WorldEnabled.org*, the City of Amsterdam launched the *Amsterdam4All* initiative to “*monitor and use AI to measure the accessibility of Amsterdam, to predict areas with sidewalk barriers, and to identify areas in need of attention*.” For their analysis, they used computer vision, LiDAR, and Crowd+AI tools like Project Sidewalk (<https://amsterdam.projectsidewalk.org>) [51].

Drawing on this momentum and our previous urban accessibility workshops at the *Spatial Data Science Symposium'21* [19], *ASSETS'22* [18], and *TRB'23* [16], we propose a workshop on the role of AI in the technical inventions and socio-political processes that impact the built environment, human mobility solutions, and interactive mapping tools for people with disabilities. To propel rich discussion, we will solicit short papers around key Urban AI + disability themes such as the following. We include citations to



This work is licensed under a Creative Commons Attribution International 4.0 License.

ASSETS '24, October 27–30, 2024, St. John's, NL, Canada

© 2024 Copyright held by the owner/author(s).

ACM ISBN 979-8-4007-0677-6/24/10

<https://doi.org/10.1145/3663548.3688550>

¹<https://cities4all.org/>

²<https://smartcities4all.org/>

initial work in this area as grounding examples but emphasize that all enumerated topics are large, open research problems:

- Mapping and assessing accessible pedestrian pathways, including sidewalk location and network topology [26], sidewalk accessibility barriers [15, 25, 63], and sidewalk surface material inference [24].
- Using AI methods to infer and analyze travel behavior of people with unique mobility needs, including wheelchair users, the elderly, the young, and comparing travel behavior outcomes for people who use mobility aids vs. not [6, 11, 23, 38, 53, 55].
- Techniques for the large-scale computation and assessment of spatiotemporal urban conditions that impact accessibility, such as shadows [40, 46] and outdoor comfort [29, 35].
- Autonomous vehicles and the perceptions by and opportunities for people with disabilities [8, 13, 14, 27, 48].
- Indoor accessibility assessment & navigation [22, 52, 58–60, 66].
- Semi-automatically tracking and visualizing accessibility changes in the built environment [41, 54].
- Intelligent wheelchairs and assistive human-robotic interaction [20, 31, 43, 49, 56].
- The impact of environmental burdens and climate change on urban accessibility, with a particular focus on environmental [4, 36, 50] and climate justice [28, 47].
- Personalized, accessible maps & geovisualizations [9, 17, 34, 42].
- Using AI-derived data for urban planning and analytics [33].
- AI challenges and opportunities related to housing and employment access and support [5, 12].
- Perceptions of Urban AI by people with disabilities, policy makers, and transportation officials [30, 32, 65, 67].
- Overarching challenges and considerations related to ethics [7, 21], bias [61, 64], policy and laws [3, 39], the digital divide [62], and data privacy and security [1, 2, 57].

As an inherently cross-disciplinary topic, we have assembled a similarly cross-disciplinary workshop organizing team, which not only helps bring together disparate perspectives but also provides access and visibility to a range of communities. Indeed, our previous workshops have a track record of convening not just academics across diverse fields such as computer science, disability studies, urban planning, political science, and architecture but also disability advocates and policymakers as well. Our inaugural ASSETS workshop in 2022³ was attended virtually by over 50 people from five continents, had a keynote by Karen Tamley, the CEO of *Access Living* and former Chair of the *US Access Board*, and 13 accepted workshop papers from over 40 co-authors.

Our workshop's overarching goals are to identify open challenges, share current work across disciplines, and spur new collaborations related to AI and urban accessibility. As a secondary goal, we aim to synthesize and publish key outcomes from our discussions similar to our *Grand Challenges in Accessible Maps* article [17], which extended from our CHI'18 SIG [10].

2 Pre-workshop Plans

Upon acceptance of our proposal, we will create an accessible workshop website at <https://accessiblecities.github.io/UrbanAccess2024> with an overview, key themes, a proposed schedule, and our CFP.

³The ASSETS'22 workshop site: <https://accessiblecities.github.io/UrbanAccess2022/>

Drawing on our cross-disciplinary organizing team, we will advertise our workshop broadly on social media, mailing lists, and our disciplinary and professional networks. To help build community, we will invite workshop participants to join an online discussion workspace like Discord, which will be used before, during, and after the workshop to foster conversation and share work. Before the workshop, we will post accepted CFP content to our workshop webpage for broad dissemination.

3 Workshop Plans

Following our previously successful workshops at *Spatial Data Science Symposium'21* [19], *ASSETS'22* [18], and *TRB'23* [16], our primary focus is on interactivity, discussion, and community building. For example, we balance research talk sessions with breakout activities, an interactive mapathon, and full group reflections.

Both the symposium workshop and the ASSETS'22 workshop were virtual while the TRB workshop was in-person in Washington DC. For a virtual setting, we have found that interactivity is particularly important to maximize engagement and catalyze discussion. For the ASSETS'24 workshop, we will introduce an interactive Crowd+AI activity where participants will have an opportunity to try a Human-AI based tool to evaluate the accessibility of the built environment and then engage in critical discussion about opportunities and challenges related to Urban AI + disability. Following the workshop, we hope to synthesize our discussions into a report—perhaps published in the *SIGACCESS Newsletter* or *ACM Interactions*.

We envision the following timeline (subject to change):

- **Aug 7, 2024:** ASSETS'24 decision notification
- **Aug 12, 2024:** Urban AI + disability workshop website launched. CFP advertising commences. Paper deadline is Sept 30, 2024.
- **Aug 14, 2024:** Finalize workshop proposal paper & submit camera ready.
- **Sept 20, 2024:** Workshop submission deadline
- **Oct 7, 2024:** Workshop notifications out
- **Oct 16, 2024:** Workshop camera ready deadline
- **Oct 18, 2024:** Accepted workshop content posted to website and shared
- **Oct 21, 2024:** Week of workshop (exact date TBD)

4 Diversity and Inclusion Criteria

We are committed to organizing an inclusive workshop and creating a safe, open space for fruitful discussion. First, we will help our participants create accessible workshop content, including their PDF submissions and their presentations—adhering to the ASSETS'24 accessibility guidelines. Second, we will survey workshop attendees to understand their specific access needs and ensure accessibility accommodations are made for all participants to fully contribute. Third, we will actively encourage broad participation from individuals representing diverse backgrounds, disciplines, and lived experience. Our workshop organizing team represents disparate topical areas from public health and urban planning to data visualization and applied machine learning. Leveraging this cross-disciplinarity, we will advertise our workshop broadly via different professional networks. Moreover, we will invite not just academics but practitioners and policy makers as well. Fourth, and finally, we

Table 1: Draft workshop schedule. As we have not yet set a clock time for the workshop to begin, all timings are relative. The schedule is subject to change based on reviewer and community feedback.

Time	Description	Type
00:00-00:10	Opening remarks	Welcome 🍌
00:10-00:40	Ice breaker activity	Activity 🗑️🔧
00:40-01:20	1st talk session	Talks 🗣️
01:20-01:40	1st breakout on key themes	Breakout discussions 🗨️
01:40-02:00	Full group shareout	Full-group discussions 🗨️
02:00-02:15	1st break	Break 🍷
02:15-03:15	Mapathon + discussion	Activity 📖💡
03:15-03:30	2nd break	Break 🍷
03:30-04:30	2nd talk session	Talks 🗣️
04:30-04:50	2nd breakout on key themes	Breakout discussions 🗨️
04:50-05:10	Full group shareout	Full-group discussions 🗨️
05:10-05:30	Wrap up & future directions	Goodbye 🍌

will support junior scholars and new members of the community by providing spotlight introductions and alternative contribution formats (e.g., pictorials, demos). Our belief is that the ASSETS workshop program provides an alternative channel into the accessibility research community—and we want to foster diverse community growth.

5 Organizers

Urban accessibility, human mobility, and the role of AI therein are intrinsically cross-disciplinary. We have assembled a similarly cross-disciplinary set of workshop co-organizers, including in urban assessment, public health, urban planning, data visualization, and applied machine learning. All have experience working with and prioritizing people with disabilities in their respective topic areas.

Jon E. Froehlich is a Professor in the Allen School of Computer Science, core faculty of the Interdisciplinary PhD Program in Urban Design and Planning at UW, and co-founder of Project Sidewalk—an open-source project aimed at mapping and assessing every sidewalk in the world using crowdsourcing + AI. He is also a founding Associate Director of the UW’s Center for Research and Education on Accessible Technology and Experiences (CRE-ATE). At UW, he directs the Makeability Lab whose mission is to “*design, build, and evaluate new interactive tools and techniques to address pressing societal challenges.*” He is the primary contact for this workshop.

Chu Li is a PhD student in Computer Science at the University of Washington. Her research explores the intersection of human-computer interaction and urban science, focusing on enhancing urban accessibility through interactive technology. She holds an MS in Architecture and Urban Design from Columbia University and an MS in Information Science from the University of Toronto. Previously, she practiced as an urban designer at Skidmore, Owings & Merrill in Chicago and as a product designer at Samsung Canada.

Maryam Hosseini is a postdoc at the MIT Department of Urban Studies and Planning, focusing on pedestrian mobility, urban accessibility, and walkability. She develops open-source tools using computer vision and machine learning to address a wide range of urban challenges such as accessibility for people with disabilities,

heat risk and poverty. Starting in 2025, Hosseini will begin as an Assistant Professor at UC Berkeley in City and Regional Planning department.

Fabio Miranda is an Assistant Professor in the Computer Science Department at University of Illinois at Chicago. His research centers on proposing techniques that allow for the interactive and collaborative analysis of large-scale data, combining interactive visualization, data management, and machine learning. In particular, he focuses on how urban visual analytics tools can help address different problems cities face by integrating data from multiple resolutions and diverse sources.

Andres Sevtsuk is Head of the City Design and Development Group and an Associate Professor of Urban Science and Planning at the Department of Urban Studies and Planning, where he also leads the City Form Lab. His research focuses on public qualities of cities, and on making urban environments more walkable, sustainable and equitable, bridging the fields of urban design, spatial analytics and mobility research.

Yochai Eisenberg is an Associate Professor in Disability and Human Development at the University of Illinois at Chicago and co-leads the Community Health and Disability Inclusion Research and Training Program. His research is at the intersection of disability, urban planning, and public health studying ways that neighborhood environments, local policies, and systems impact health behaviors and health outcomes for people with disabilities using a blend of big data analytics, policy evaluation, and community engaged research.

6 Call for Participation

Our draft Call for Participation (CFP) is below:

How will AI transform urban infrastructure for people with disabilities—from public transportation and sidewalks to the design and use of buildings, housing, parks, and transit stations? What new mobility tools and techniques will AI enable from autonomous vehicles and micro-mobility solutions to personalized routing and accessible interactive maps? In this workshop, we examine the emerging role of AI in the design of equitable

and accessible cities, transportation systems, and interactive tools for mapping and navigation.

We invite short papers (broadly construed), including experience reports, position papers, vision pieces, demonstrations, pictorials, or research summaries up to approximately 2,000 words on this topic. For the word count, you can exclude figures, tables, captions, and the reference list. As we aim for a broad representation of viewpoints, disciplines, and work practices, please choose a format that you feel best conveys your work.

Submitted artifacts should not be anonymized and, in addition to their primary content, should include a bio of each author and rationale for attending the workshop. PDF submissions should be accessible following the ASSETS'24 Accessibility Guidelines. Artifacts will be reviewed and selected by the co-organizers to balance topics, geographies, and communities of focus. Accepted authors will be required to register and virtually attend the workshop via Zoom on <date TBD>.

Our overarching goals are to identify open challenges, share current work across disciplines, and spur new collaborations in Urban AI + disability. As a secondary goal, we aim to synthesize and publish our discussions together in a jointly authored report perhaps to the SIGACCESS Newsletter or beyond.

Please join us. Contact: urbanaccess2024@cs.uw.edu.

Acknowledgments

This workshop is supported, in part, by NSF #2125087, #2411222, and #2411223.

References

- [1] Taslima Akter, Tousif Ahmed, Apu Kapadia, and Swami Manohar Swaminathan. 2020. Privacy Considerations of the Visually Impaired with Camera Based Assistive Technologies: Misrepresentation, Impropriety, and Fairness. In *Proceedings of the 22nd International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS '20)*. Association for Computing Machinery, New York, NY, USA, Article 32, 14 pages. <https://doi.org/10.1145/3373625.3417003>
- [2] Taslima Akter, Bryan Dosono, Tousif Ahmed, Apu Kapadia, and Bryan Semaan. 2020. "I am uncomfortable sharing what I can't see": Privacy Concerns of the Visually Impaired with Camera Based Assistive Applications. In *29th USENIX Security Symposium (USENIX Security 20)*. 1929–1948.
- [3] Suha Alawadhi, Armando Aldama-Nalda, Hafedh Chourabi, J. Ramon Gil-Garcia, Sofia Leung, Sehl Mellouli, Taewoo Nam, Theresa A. Pardo, Hans J. Scholl, and Shawn Walker. 2012. Building Understanding of Smart City Initiatives. In *Electronic Government*, Hans J. Scholl, Marijn Janssen, Maria A. Wimmer, Carl Erik Moe, and Leif Skiftenes Flak (Eds.). Springer Berlin Heidelberg, Berlin, Heidelberg, 40–53.
- [4] Zeynep Toker Alessandro Rigolon and Nara Gasparian. 2018. Who has more walkable routes to parks? An environmental justice study of Safe Routes to Parks in neighborhoods of Los Angeles. *Journal of Urban Affairs* 40, 4 (2018), 576–591. <https://doi.org/10.1080/07352166.2017.1360740>
- [5] Elisavet Athanasia Alexiadou. 2022. *Artificial Intelligence in Disability Employment: Incorporating a Human Rights Approach*. T.M.C. Asser Press, The Hague, 135–148. https://doi.org/10.1007/978-94-6265-523-2_7
- [6] Rounaq Basu and Joseph Ferreira. 2020. Understanding household vehicle ownership in Singapore through a comparison of econometric and machine learning models. *Transportation Research Procedia* 48 (2020), 1674–1693. <https://doi.org/10.1016/j.trpro.2020.08.207>
- [7] Cynthia L. Bennett and Os Keyes. 2020. What is the point of fairness? disability, AI and the complexity of justice. *SIGACCESS Access. Comput.* 125, Article 5 (mar 2020), 1 pages. <https://doi.org/10.1145/3386296.3386301>
- [8] Roger Bennett, Rohini Vijaygopal, and Rita Kottasz. 2019. Attitudes towards autonomous vehicles among people with physical disabilities. *Transportation Research Part A: Policy and Practice* 127 (2019), 1–17. <https://doi.org/10.1016/j.tra.2019.07.002>
- [9] Nicholas Bolten and Anat Caspi. 2019. AccessMap Website Demonstration: Individualized, Accessible Pedestrian Trip Planning at Scale (ASSETS '19). Association for Computing Machinery, New York, NY, USA, 676–678. <https://doi.org/10.1145/3308561.3354598>
- [10] Anke M. Brock, Jon E. Froehlich, João Guerreiro, Benjamin Tannert, Anat Caspi, Johannes Schöning, and Steve Landau. 2018. SIG: Making Maps Accessible and Putting Accessibility in Maps. In *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems (CHI EA '18)*. Association for Computing Machinery, New York, NY, USA, 1–4. <https://doi.org/10.1145/3170427.3185373>
- [11] Ron N. Buliung, Kristian Larsen, Guy Faulkner, and Timothy Ross. 2017. Children's independent mobility in the City of Toronto, Canada. *Travel Behaviour and Society* 9 (10 2017), 58–69. <https://doi.org/10.1016/j.tbs.2017.06.001>
- [12] Caroline Compton, Caroline Compton, and Jessie M. Hohmann. 2023. AI and the Right to Housing. In *Human Rights and Artificial Intelligence: A Deskbook*, Temperman Quintavalla (Ed.). Oxford University Press. <https://ssrn.com/abstract=4322086> UNSW Law Research.
- [13] Paige Cordts, Shelia R. Cotten, Tongbin Qu, and Tamara Reid Bush. 2021. Mobility challenges and perceptions of autonomous vehicles for individuals with physical disabilities. *Disability and Health Journal* 14, 4 (2021), 101131. <https://doi.org/10.1016/j.dhjo.2021.101131>
- [14] Brad E. Dicianno, Sivashankar Sivakanthan, S. Andrea Sundaram, Shantanu Satpute, Hailee Kulich, Elizabeth Powers, Nikitha Deepak, Rebecca Russell, Rosemarie Cooper, and Rory A. Cooper. 2021. Systematic review: Automated vehicles and services for people with disabilities. *Neuroscience Letters* 761 (2021), 136103. <https://doi.org/10.1016/j.neulet.2021.136103>
- [15] Michael Duan, Shosuke Kiami, Logan Milandin, Johnson Kuang, Michael Saugstad, Maryam Hosseini, and Jon E. Froehlich. 2022. Scaling Crowd+AI Sidewalk Accessibility Assessments: Initial Experiments Examining Label Quality and Cross-city Training on Performance. In *Proceedings of the 24th International ACM SIGACCESS Conference on Computers and Accessibility*. ACM, Athens Greece, 1–5. <https://doi.org/10.1145/3517428.3550381>
- [16] Yochai Eisenberg, Judy L. Shanley, Anna Zivarts, Brent Chamberlain, Keith Christensen, Minoob Abrishami, and Jon E. Froehlich. 2024. At the Intersection of Disability Justice, Pedestrian Safety, and Health. In *103rd Transportation Research Board (TRB) Annual Meeting* (Washington DC). 2 pages.
- [17] Jon E. Froehlich, Anke M. Brock, Anat Caspi, João Guerreiro, Kotaro Hara, Reuben Kirkham, Johannes Schöning, and Benjamin Tannert. 2019. Grand challenges in accessible maps. *Interactions* 26, 2 (feb 2019), 78–81. <https://doi.org/10.1145/3301657>
- [18] Jon E. Froehlich, Yochai Eisenberg, Maryam Hosseini, Fabio Miranda, Marc Adams, Anat Caspi, Holger Dieterich, Heather Feldner, Aldo Gonzalez, Claudina De Gyves, Joy Hammel, Reuben Kirkham, Melanie Kneisel, Delphine Labbé, Steve J. Mooney, Victor Pineda, Cláudia Pinheiro, Ana Rodríguez, Manaswi Saha, Michael Saugstad, Judy Shanley, Ather Sharif, Qing Shen, Claudio Silva, Maarten Sukel, Eric K. Tokuda, Sebastian Felix Zappe, and Anna Zivarts. 2022. The Future of Urban Accessibility for People with Disabilities: Data Collection, Analytics, Policy, and Tools. In *Proceedings of the 24th International ACM SIGACCESS Conference on Computers and Accessibility*. ACM, Athens Greece, 1–8. <https://doi.org/10.1145/3517428.3550402>
- [19] Jon E. Froehlich, Fabio Miranda, Maryam Hosseini, Nicholas Bolten, Anat Caspi, Roberto M. Cesar Jr., Holger Dieterich, Yochai Eisenberg, Victor Pineda, Manaswi Saha, Mikey Saugstad, Andres Sevtsuk, Cláudio T. Silva, Eric K. Tokuda, and Sebastian Felix Zappe. 2021. The Future of Global-Scale Spatial Data Collection and Analyses on Urban (in)Accessibility for People with Disabilities. In *Spatial Data Science Symposium 2021 (Virtual)*. 2 pages.
- [20] Carlo Grigioni, Franca Corradini, Alessandro Antonucci, Jérôme Guzzi, and Francesco Flammini. 2024. Safe Road-Crossing by Autonomous Wheelchairs: a Novel Dataset and its Experimental Evaluation. arXiv:2403.08984
- [21] Anhong Guo, Ece Kamar, Jennifer Wortman Vaughan, Hanna Wallach, and Meredith Ringel Morris. 2020. Toward fairness in AI for people with disabilities SBG@a research roadmap. *SIGACCESS Access. Comput.* 125, Article 2 (mar 2020), 1 pages. <https://doi.org/10.1145/3386296.3386298>
- [22] Hwei-Shin Harriman, Dragan Ahmetovic, Sergio Mascetti, Darren Moyle, Michael Evans, and Paul Ruvolo. 2021. Clew3D: Automated Generation of O&M Instructions Using LIDAR-Equipped Smartphones. In *Proceedings of the 23rd International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS '21)*. Association for Computing Machinery, New York, NY, USA, Article 54, 3 pages. <https://doi.org/10.1145/3441852.3476564>
- [23] Mia E Hoffman, Katherine M Steele, Jon E. Froehlich, Kyle N Winfree, and Heather A Feldner. 2024. Off to the park: a geospatial investigation of adapted ride-on car usage. *Disability and Rehabilitation: Assistive Technology* 19, 5 (2024), 1890–1898.
- [24] Maryam Hosseini, Fabio Miranda, Jianzhe Lin, and Claudio T. Silva. 2022. City-Surfaces: City-scale semantic segmentation of sidewalk materials. *Sustainable Cities and Society* 79 (April 2022), 103630. <https://doi.org/10.1016/j.scs.2021.103630>
- [25] Maryam Hosseini, Mikey Saugstad, Fabio Miranda, Andres Sevtsuk, Claudio T. Silva, and Jon E. Froehlich. 2022. Towards Global-Scale Crowd+AI Techniques to Map and Assess Sidewalks for People with Disabilities. arXiv:2206.13677
- [26] Maryam Hosseini, Andres Sevtsuk, Fabio Miranda, Roberto M. Cesar, and Claudio T. Silva. 2023. Mapping the walk: A scalable computer vision approach for

- generating sidewalk network datasets from aerial imagery. *Computers, Environment and Urban Systems* 101 (April 2023), 101950. <https://doi.org/10.1016/j.compenvurbysys.2023.101950>
- [27] Jinuk Hwang, Wei Li, Laura Stough, Chanam Lee, and Katherine Turnbull. 2020. A focus group study on the potential of autonomous vehicles as a viable transportation option: Perspectives from people with disabilities and public transit agencies. *Transportation Research Part F: Traffic Psychology and Behaviour* 70 (2020), 260–274. <https://doi.org/10.1016/j.trf.2020.03.007>
- [28] Sonja Klinsky and Anna Mavrogianni. 2020. Climate justice and the built environment. *Buildings and Cities* 1, 1 (2020), 412–428.
- [29] Minchu Kulkarni, Chu Li, Jaye Jungmin Ahn, Katrina Oi Yau Ma, Zhihan Zhang, Michael Saugstad, Kevin Wu, Yochai Eisenberg, Valerie Novack, Brent Chamberlain, and Jon E. Froehlich. 2023. BusStopCV: A Real-time AI Assistant for Labeling Bus Stop Accessibility Features in Streetscape Imagery. In *Proceedings of the 25th International ACM SIGACCESS Conference on Computers and Accessibility* (New York, NY, USA) (ASSETS '23). Association for Computing Machinery, New York, NY, USA, Article 91, 6 pages. <https://doi.org/10.1145/3597638.3614481>
- [30] Delphine Labbé, Yochai Eisenberg, Devon Snyder, Judy Shanley, Joy M Hammel, and Jon E Froehlich. 2023. Multiple-Stakeholder Perspectives on Accessibility Data and the Use of Socio-Technical Tools to Improve Sidewalk Accessibility. *Disabilities* 3, 4 (2023), 621–638.
- [31] Jesse Leaman and Hung Manh La. 2017. A Comprehensive Review of Smart Wheelchairs: Past, Present, and Future. *IEEE Transactions on Human-Machine Systems* 47, 4 (2017), 486–499. <https://doi.org/10.1109/THMS.2017.2706727>
- [32] Anu Lehtio, Maria Hartikainen, Saara Ala-Luopa, Thomas Olsson, and Kaisa Väinänen. 2023. Understanding citizen perceptions of AI in the smart city. *AI & SOCIETY* 38, 3 (jun 2023), 1123–1134. <https://doi.org/10.1007/s00146-022-01589-7>
- [33] Chu Li, Lisa Orii, Mikey Saugstad, Stephen J. Mooney, Yochai Eisenberg, Delphine Labbé, Joy Hammel, and Jon E. Froehlich. 2022. A Pilot Study of Sidewalk Equity in Seattle Using Crowdsourced Sidewalk Assessment Data. arXiv:2211.11545 [physics.soc-ph] <https://arxiv.org/abs/2211.11545>
- [34] Chu Li, Pang Yuren, Athar Sharif, Arnavi Chheda-Kothary, Jeffrey Heer, and Jon E. Froehlich. 2024. AltGeoViz: Facilitating Accessible Geovisualization. In *(to appear in) IEEE TVCG (IEEE VIS '24 Short Papers)*.
- [35] Pengyuan Liu, Tianhong Zhao, Junjie Luo, Binyu Lei, Mario Frei, Clayton Miller, and Filip Biljecki. 2023. Towards Human-centric Digital Twins: Leveraging Computer Vision and Graph Models to Predict Outdoor Comfort. *Sustainable Cities and Society* 93 (2023), 104480. <https://doi.org/10.1016/j.scs.2023.104480>
- [36] Kate Lowe. 2016. Environmental Justice and Pedestrianism: Sidewalk Continuity, Race, and Poverty in New Orleans, Louisiana. *Transportation Research Record* 2598, 1 (2016), 119–123. <https://doi.org/10.3141/2598-14>
- [37] Aale Luusua and Johanna Ylipulli. 2020. Urban AI: Formulating an Agenda for the Interdisciplinary Research of Artificial Intelligence in Cities. In *Companion Publication of the 2020 ACM Designing Interactive Systems Conference*. ACM, Eindhoven Netherlands, 373–376. <https://doi.org/10.1145/3393914.3395905>
- [38] Noreen C. McDonald, Ruth L. Steiner, Chanam Lee, Tori Rhoulac Smith, Xuemei Zhu, and Yizhao Yang. 2014. Impact of the Safe Routes to School Program on Walking and Bicycling. *Journal of the American Planning Association* 80 (4 2014), 153–167. Issue 2. <https://doi.org/10.1080/01944363.2014.956654>
- [39] Nancy Micozzi and Tan Yigitcanlar. 2022. Understanding Smart City Policy: Insights from the Strategy Documents of 52 Local Governments. *Sustainability* 14, 16 (2022). <https://doi.org/10.3390/su141610164>
- [40] Fabio Miranda, Harish Doraiswamy, Marcos Lage, Luc Wilson, Mondrian Hsieh, and Cláudio T. Silva. 2019. Shadow Accrual Maps: Efficient Accumulation of City-Scale Shadows Over Time. *IEEE Transactions on Visualization and Computer Graphics* 25, 3 (2019), 1559–1574. <https://doi.org/10.1109/TVCG.2018.2802945>
- [41] Fabio Miranda, Maryam Hosseini, Marcos Lage, Harish Doraiswamy, Graham Dove, and Cláudio T. Silva. 2020. Urban Mosaic: Visual Exploration of Streetscapes Using Large-Scale Image Data. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) (CHI '20). Association for Computing Machinery, New York, NY, USA, 1–15. <https://doi.org/10.1145/3313831.3376399>
- [42] Gustavo Moreira, Maryam Hosseini, Md Nafzul Alam Nipu, Marcos Lage, Nivan Ferreira, and Fabio Miranda. 2024. The Urban Toolkit: A Grammar-Based Framework for Urban Visual Analytics. *IEEE Transactions on Visualization and Computer Graphics* 30, 1 (2024), 1402–1412. <https://doi.org/10.1109/TVCG.2023.3326598>
- [43] Amal Nanavati, Vinitha Ranganeni, and Maya Cakmak. 2023. Physically Assistive Robots: A Systematic Review of Mobile and Manipulator Robots That Physically Assist People with Disabilities. *Annual Review of Control, Robotics, and Autonomous Systems* (2023). <https://doi.org/10.1146/annurev-control-062823-024352>
- [44] United Nations. 2024. The Sustainable Development Goals. <https://sdgs.un.org/goals> Accessed June 20, 2024.
- [45] United Nations Department of Economic and Social Affairs (DESA). 2024. Convention on the Rights of Persons with Disabilities - Articles. <https://social.desa.un.org/issues/disability/crpd/convention-on-the-rights-of-persons-with-disabilities-articles> Accessed June 20, 2024.
- [46] Kazi Omar, Gustavo Moreira, Daniel Hodczak, Maryam Hosseini, Nico Colaninno, Marcos Lage, and Fabio Miranda. 2024. Deep Umbra: A Generative Approach for Sunlight Access Computation in Urban Spaces. *IEEE Transactions on Big Data* 01 (mar 2024), 1–13. <https://doi.org/10.1109/TBDDATA.2024.3382964>
- [47] Luke Parry, Gemma Davies, Oriana Almeida, Gina Frausin, André de Moraés, Sergio Rivero, Naziano Filizola, and Patricia Torres. 2018. Social vulnerability to climatic shocks is shaped by urban accessibility. *Annals of the American Association of Geographers* 108, 1 (2018), 125–143. <https://doi.org/10.1080/24694452.2017.1325726>
- [48] Ronik Ketankumar Patel, Roya Etmnani-Ghasrodashti, Sharareh Kermanshachi, Jay Michael Rosenberger, and David Weinreich. [n. d.]. *Exploring Preferences towards Integrating the Autonomous Vehicles with the Current Microtransit Services: A Disability Focus Group Study*. 355–366. <https://doi.org/10.1061/97807848483534.031> arXiv:<https://ascelibrary.org/doi/pdf/10.1061/97807848483534.031>
- [49] Vinitha Ranganeni and Maya Cakmak. 2024. Accessible Tele-Operation Interfaces for Assistive Robots. In *Companion of the 2024 ACM/IEEE International Conference on Human-Robot Interaction (HRI '24)*. Association for Computing Machinery, New York, NY, USA, 91–93. <https://doi.org/10.1145/3610978.3641087>
- [50] Kristen E. Ravi, Noelle L. Fields, and Holly Dabelko-Schoeny. 2021. Outdoor spaces and buildings, transportation, and environmental justice: A qualitative interpretive meta-synthesis of two age-friendly domains. *Journal of Transport & Health* 20 (2021), 100977. <https://doi.org/10.1016/j.jth.2020.100977>
- [51] Manaswi Saha, Michael Saugstad, Hanuma Teja Maddali, Aileen Zeng, Ryan Holland, Steven Bower, Aditya Dash, Sage Chen, Anthony Li, Kotaro Hara, and Jon Froehlich. 2019. Project Sidewalk: A Web-based Crowdsourcing Tool for Collecting Sidewalk Accessibility Data At Scale. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) (CHI '19). Association for Computing Machinery, New York, NY, USA, 1–14. <https://doi.org/10.1145/3290605.3300292>
- [52] Daisuke Sato, Uran Oh, João Guerreiro, Dragan Ahmetovic, Kakuya Naito, Hironobu Takagi, Kris M. Kitani, and Chieko Asakawa. 2019. NavCog3 in the Wild: Large-scale Blind Indoor Navigation Assistant with Semantic Features. *ACM Trans. Access. Comput.* 12, 3, Article 14 (aug 2019), 30 pages. <https://doi.org/10.1145/3340319>
- [53] Andres Sevtuk, Xiaojiang Li, Rounaq Basu, and Raul Kalvo. 2021. A big data approach to understanding pedestrian route choice preferences - Evidence from San Francisco. *Travel Behavior and Society* 25 (2021), 41–51. Issue October. <https://doi.org/10.1016/j.tbs.2021.05.010>
- [54] Athar Sharif, Paari Gopal, Michael Saugstad, Shiven Bhatt, Raymond Fok, Galen Weld, Kavi Asher Mankoff Dey, and Jon E. Froehlich. 2021. Experimental Crowd-AI Approaches to Track Accessibility Features in Sidewalk Intersections Over Time. In *Proceedings of the 23rd International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS '21)*. Association for Computing Machinery, New York, NY, USA, Article 65, 5 pages. <https://doi.org/10.1145/3441852.3476549>
- [55] Mohammad Sadra Sharifi, Keith Christensen, Anthony Chen, Daniel Stuart, Yong Seog Kim, and YangQuan Chen. 2017. A large-scale controlled experiment on pedestrian walking behavior involving individuals with disabilities. *Travel Behaviour and Society* 8 (7 2017), 14–25. <https://doi.org/10.1016/j.tbs.2017.03.003>
- [56] Sivashankar Sivakanthan, Jorge I Candiotti, S. Andrea Sundaram, Courtney Battles, Brandon J Daveler, Cheng-Shiu Chung, Garrett G Grindle, Rosemarie Cooper, Brad E Dicianno, and Rory A Cooper. 2020. Usability evaluation of attitude control for a robotic wheelchair for tip mitigation in outdoor environments. *Medical Engineering & Physics* 82 (2020), 86–96. <https://doi.org/10.1016/j.medengphy.2020.07.002>
- [57] Abigale Stangl, Kristina Shiroma, Nathan Davis, Bo Xie, Kenneth R. Fleischmann, Leah Findlater, and Danna Gurari. 2022. Privacy Concerns for Visual Assistance Technologies. *ACM Trans. Access. Comput.* 15, 2, Article 15 (may 2022), 43 pages. <https://doi.org/10.1145/3517384>
- [58] Xia Su, Ruiqi Chen, Richard Weiye Zhang, Jingwei Ma, and Jon E. Froehlich. 2024. A Demo of DIAM: Drone-based Indoor Accessibility Mapping. In *Extended Abstract Proceedings of the 2024 ACM Symposium on User Interface Software and Technology* (Pittsburgh, PA), 3 pages.
- [59] Xia Su, Daniel Campos Zamora, and Jon E. Froehlich. 2024. RAIS: Towards A Robotic Accessibility Indoor Scanner Using Commodity Hardware. In *Extended Abstract Proceedings of the 26th International ACM SIGACCESS Conference on Computers and Accessibility* (St. John's, Newfoundland and Labrador), 3 pages.
- [60] Xia Su, Han Zhang, Kaimeing Cheng, Jaewook Lee, Qiaochu Liu, Wyatt Olson, and Jon E. Froehlich. 2024. RASSAR: Room Accessibility and Safety Scanning in Augmented Reality. In *Proceedings of the CHI Conference on Human Factors in Computing Systems*. ACM, Honolulu HI USA, 1–17. <https://doi.org/10.1145/3613904.3642140>
- [61] Shari Trewin, Sara Basson, Michael Muller, Stacy Branham, Jutta Treviranus, Daniel Gruen, Daniel Hebert, Natalia Lyckowski, and Erich Manser. 2019. Considerations for AI fairness for people with disabilities. *AI Matters* 5, 3 (dec 2019), 40–63. <https://doi.org/10.1145/3362077.3362086>
- [62] University of New South Wales, Lemuria Carter, Dapeng Liu, University of New South Wales, Caley Cantrell, and Virginia Commonwealth University. 2020. Exploring the Intersection of the Digital Divide and Artificial Intelligence: A Hermeneutic Literature Review. *AIS Transactions on Human-Computer Interaction* 12, 4 (Dec. 2020), 253–275. <https://doi.org/10.17705/1thci.00138>

- [63] Galen Weld, Esther Jang, Anthony Li, Aileen Zeng, Kurtis Heimerl, and Jon E. Froehlich. 2019. Deep Learning for Automatically Detecting Sidewalk Accessibility Problems Using Streetscape Imagery. In *The 21st International ACM SIGACCESS Conference on Computers and Accessibility*. ACM, Pittsburgh PA USA, 196–209. <https://doi.org/10.1145/3308561.3353798>
- [64] Meredith Whittaker, Meryl Alper, Cynthia L Bennett, Sara Hendren, Liz Kaziunas, Mara Mills, Meredith Ringel Morris, Joy Rankin, Emily Rogers, Marcel Salas, et al. 2019. Disability, Bias, and AI. *AI Now Institute* 8 (2019).
- [65] Tan Yigitcanlar, Duzgun Agdas, and Kenan Degirmenci. 2023. Artificial intelligence in local governments: perceptions of city managers on prospects, constraints and choices. *AI & SOCIETY* 38, 3 (jun 2023), 1135–1150. <https://doi.org/10.1007/s00146-022-01450-x>
- [66] Chris Yoon, Ryan Louie, Jeremy Ryan, MinhKhang Vu, Hyegi Bang, William Derksen, and Paul Ruvolo. 2019. Leveraging Augmented Reality to Create Apps for People with Visual Disabilities: A Case Study in Indoor Navigation (ASSETS '19). Association for Computing Machinery, New York, NY, USA, 210–221. <https://doi.org/10.1145/3308561.3353788>
- [67] Shimi Zhou, Eleanor T. Loiacono, and Nima Kordzadeh. 2023. Smart cities for people with disabilities: a systematic literature review and future research directions. *European Journal of Information Systems* (Dec. 2023), 1–18. <https://doi.org/10.1080/0960085X.2023.2297974>