Designing Smart Over a Distance for Sustainable Communities: Reflecting on AI, the Metaverse, and the Role of HCI for Addressing the Sustainable Development Goals

Joel Fredericks

The University of Sydney, joel.fredericks@sydney.edu.au

Hilary Davis

Swinburne University of Technology, hdavis@swin.edu.au

Callum Parker

The University of Sydney, callum.parker@sydney.edu.au

Martin Tomitsch

University of Technology Sydney, martin.tomitsch@uts.edu.au

Glenda Amayo Caldwell

Queensland University of Technology, g.caldwell@qut.edu.au

Marcus Foth

Queensland University of Technology, m.foth@qut.edu.au

Alexandra Crosby

University of Technology Sydney, alexandra.crosby@uts.edu.au

ABSTRACT

In this rapidly evolving era of smart city initiatives, the need for innovative, inclusive, and sustainable solutions is paramount. Existing approaches often prioritise technology over social, economic, and environmental factors, limiting their ability to tackle critical challenges in urban, regional, and rural environments. To address these limitations, a collaborative and participatory approach to smart city design has gained momentum, emphasising inclusivity and shared ownership. This workshop seeks to establish best practices for evolving human-computer interaction design, aligning with the United Nations' sustainable development goals. It explores the implications of technological advancements such as AI and the metaverse, aiming to ensure their integration supports principles of fairness, transparency, and social equity. Furthermore, it addresses the importance of "designing over a distance" to promote global collaboration and problem-solving. We are specifically interested in ways of "designing smart" by engaging and working with communities to address complex challenges, such as social inequality, economic disparity and environmental degradation, to build more sustainable, resilient and socially "just" communities.

CCS CONCEPTS

Social and professional topics → Professional topics → Computing industry → Sustainability; Human-centred computing → Interaction design → Interaction design process and methods → Participatory design

KEYWORDS

Participatory design, Sustainable Development Goals, post-anthropocentric design, institutioning, more-than-human futures, smart cities, human-computer interaction, sustainability

1   Introduction

In recent years, local communities have been on the front lines of social, political, and environmental challenges that demand innovative, inclusive and smart solutions. The global emergence of smart city initiatives and infrastructure has led to the development of new technologies that aim to create efficient, connected, and intelligent urban, regional, and rural environments [2]. However, these approaches have often prioritised technology over social, economic, and environmental factors, limiting their potential to address critical issues, such as inequality, well-being, material living conditions, and environmental degradation [9].

To address these limitations, the call for a more collaborative and participatory approach to smart city design has gained momentum. Leveraging modern information and communication technologies offers opportunities to engage people in more innovative and meaningful ways. This can be achieved by involving a diverse range of stakeholders in the early design stages, thereby ensuring inclusivity, shared ownership, responsibility, and investment in the success of evolving urban, regional, and rural environments. In response to the challenges of social inequality, economic disparity, and environmental degradation, the United Nations developed the 2030 Agenda for Sustainable Development, placing a strong emphasis on promoting the well-being of people, preserving the planet, and enhancing prosperity [10]. Comprising of 17 sustainable development goals, it stands as a comprehensive framework to address poverty, protect the planet, foster peace, and encourage collaborative partnerships between countries and stakeholders. Incorporating sustainable development principles into the fabric of smart city design enables researchers, educators, governments, NGOs, private enterprises, and others to address various social, economic, and environmental challenges faced by communities globally. However, while some projects worldwide incorporate dimensions beyond smart technology, there is limited evidence suggesting that communities claiming to be "smart" effectively achieve their sustainable development targets [13].

Moreover, the advancement of technology, particularly artificial intelligence (AI) and the concept of the metaverse, presents new possibilities and challenges for smart cities [1, 12]. AI technologies have the potential to optimise urban systems, enhance decision-making processes, and improve the overall quality of life. However, their deployment and impact must be carefully managed to ensure fairness, transparency, and accountability. Similarly, the concept of the metaverse, a virtual reality space where people can interact and engage with digital counterparts of real-world environments, opens up opportunities for innovative urban experiences and participatory design [12]. The metaverse also raises concerns about privacy, data ownership, and the potential for exclusionary practices.

In addition to these technological advancements, there is a growing need to address the concept of "designing over a distance". With the increasing interconnectedness of communities and the rise of remote work and collaboration, which was brought to prominence during the COVID-19 (2019-2023) pandemic, it is crucial to embrace methods that allow us to design over a distance. As academics, researchers and designers, this includes embracing co-design and participatory methods both for research [4] [5] and teaching practices [11]. This approach enables the involvement of stakeholders from different locations, allowing for diverse perspectives and expertise to be integrated into the design and decision-making processes [4]. By embracing "designing over a distance", smart cities and communities have a greater potential to foster global collaboration, knowledge exchange, and collective problem-solving.

In the context of smart cities, participatory design and co-design approaches have been adopted to increase collaboration with diverse and marginalised communities in the design and utilisation of networked sensing technologies. However, these ideals of activism, community engagement, and democratisation through co-design have primarily focused on individual users rather than larger institutions or organisations.

This workshop aims to build consensus based on best practice principles about evolving HCI design approaches to address these challenges, particularly within the context of the sustainable development goals (SDGs) (Figure 1). Furthermore, it seeks to explore the implications of technological advances, such as AI and the metaverse, on the design and development of smart cities, ensuring that these advancements align with the principles of inclusivity, sustainability, and social equity.
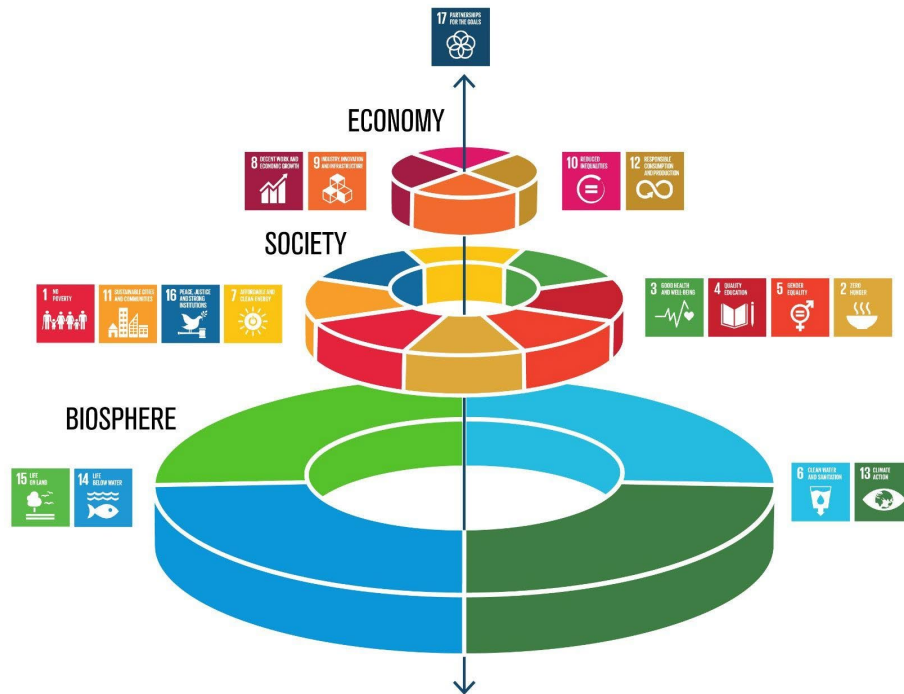

Figure 1: UN Sustainable Development Goals. Source: Azote for Stockholm Resilience Centre, Stockholm University, CC BY 4.0

2 Workshop format

This workshop builds on our previous workshops at OzCHI 2019 [6] and PDC 2022 [5]. It explores and develops the notion of designing smart and embraces this year's OzCHI theme of "Design from a Distant World". Our workshop will continue the debate on sustainable development goals across disciplinary boundaries within the field of HCI research, including interaction design, urban planning, architecture, environmental humanities, community development and others. The objective of our workshop is to bring academics, researchers and practitioners together to explore and debate new and trusted approaches for co-designing communities, cities, regional centres, services and experiences of the future. We do this by engaging a variety of people with diverse professional and personal interests in the design process.

Submissions to this workshop should take the concept of "designing smart" to the next level by exploring strategies, mechanisms, stakeholders (and their roles), technologies, design approaches, and methodologies that look at "scaling-up" efforts to go beyond sustainable development on an individual level and push and scale up to the broader community, city, state, national or planetary level. Specifically, submissions should either address systemic issues pertinent across different layers or align with one or more of the UN sustainable development goals[1] (see Figure 1).

---

[1] UN sustainable development goals -
https://sustainabledevelopment.un.org/post2015/transformingourworld

Topics of interest for this workshop include but are not limited to the following areas of HCI scholarship and inquiry:

- HCI, interaction design, participatory design that explore political issues, such as designing for existential crises, institutioning, re-politicising HCI
- HCI for civic design, community activism, community engagement
- HCI for smart engagement and smart city planning and design
- HCI and post-anthropocentric design, post-humanist design, more-than-human futures
- HCI and sustainability
- Accessibility and inclusivity of future smart cities
- HCI for behaviour change towards sustainable lifestyles
- Human-centred design for SDG implementation
- Human-centred mobility and transportation design
- Ethical considerations in AI-driven smart cities
- Empowering citizen participation through digital platforms
- Augmented reality (AR) and virtual reality (VR) applications for urban planning and design
- HCI and new economic paradigms such as circular economy, doughnut economics, degrowth, voluntary simplicity, prosperous decent, cooperativism
- HCI for building stronger more resilient communities

Table 1: Workshop activities

Workshop Activity	Time (AEST)
Welcome	9:30am
Keynote speaker	9:40am
Group activity session 1	10:10am
Morning tea	10:40am
Group activity session 2	11:00am
Lunch	12:00pm
Speculative design challenge	1:00pm
Afternoon tea	2.30pm
Group presentations	2.40pm
Workshop wrap-up	3.45pm

2.1 Participant recruitment

We will utilise the OzCHI conference communication channels, our own networks (including from the previous workshops) and the organisers' personal and institutional networks to disseminate the call for expressions of interest. We invite expressions of interest for attendance from academics, researchers, practitioners, and other interested people via an online registration form that includes questions relating to: (1) the participants' positioning in terms of the type of work they conduct; (2) the SDG(s) they are seeking to address; (3) the context in which their research is taking place; (4) the community with which they engage (the community does not have to be identified or named); (5) the participatory design/co-design approach employed to work with the community; and (6) one opportunity and challenge of their work. We will select up to 20 submissions, which will be curated by the workshop organisers based on their relevance to the workshop theme and goal. We will organise this repository of resources prior to the workshop under relevant SDGs and community participation approaches to pre-populate a thematic approach to the workshop. Before the workshop, we will reach out to participants, asking them what key topics they would like to discuss at the workshop based on the thematic groupings. Our thematic grouping and participants' responses will then inform activities and discussions.

2.2 Workshop organisers and expertise

The workshop organisers are long-term collaborators with a shared vision of working in tandem with diverse community groups to create just, resilient and sustainable communities. Together and individually, we have organised a series of design workshops and other co-design sessions focusing on participatory methods to bring together researchers, designers and practitioners [3, 5–7]. Three of the organisers were contributing co-editors of a world-first journal special issue on *"The Digital fringe and social participation through interaction design"* in the Journal of Community Informatics [8]. The organisers have a special issue proposal, '*The Role of Participatory Planning and Design in Addressing the UN Sustainable Development Goals',* accepted in a Q2 journal - the Urban Planning Journal (vol 10, Issue 1). Workshop participants will be encouraged to submit a journal article to this new special issue.

Joel Fredericks is a Lecturer in Design at The University of Sydney's School of Architecture, Design and Planning. His research is at the intersection of interaction design, community engagement, urbanism, and smart cities. Joel has worked on a variety of transdisciplinary research projects that incorporate participatory methods to design, develop and deploy interactive systems that enhance community engagement and contribute to collaborative city-making. Joel has authored and co-authored in numerous publications and books. Most notably, he was the lead author of *Media Architecture Compendium Vol.2 – Concepts, Methods, Practice*, which draws on academic research and global studies to present an evolutionary account of concepts, methods, and practices for bringing media architecture thinking into projects.

Hilary Davis is a senior social science researcher with a Human-Computer Interaction background. Originally from New Zealand, she has a strong focus on research for social impact, particularly for people from marginalised or diverse backgrounds. She is interested in community outreach methodologies and employs place-based approaches. She conducts research with networks of stakeholders in urban, regional and rural Australian communities and has worked with a range of rural health service organisations. You can usually find her online or dodging kangaroos somewhere in the Australian outback.

*Callum Parke*r is a Lecturer in Interaction Design at the Urban Interfaces Lab in the University of Sydney's School of Architecture, Design and Planning. Callum's research seeks to gain new understanding of interactive digital city interfaces and their place within urban environments, contributing towards the broader smart city. He is specifically focused on leveraging cutting edge technologies such as pervasive displays, {augmented, virtual, and mixed} realities, and media architecture.

Glenda Amayo Caldwell is an Associate Professor in Architecture, and the Academic Lead Research in the School of Architecture and Built Environment, Faculty of Engineering at the Queensland University of Technology (QUT) in Brisbane, Australia. She is an architecture and design scholar with expertise in physical, digital, and robotic fabrication, leading Industry 4.0 innovation through human-centred and participatory design research in design robotics and media architecture.

Martin Tomitsch is a Professor and Head of the Transdisciplinary School at the University of Technology Sydney, a founding member of the Media Architecture Institute, the Urban Interfaces Lab, and the Life-centred Design Collective. His books include *Making Cities Smarter* (Jovis), *Design Think Make Break Repeat* (BIS), and *Designing Tomorrow* (BIS).

Marcus Foth is a passionate wombassador and beekeeper. In his spare time, he is Professor of Urban Informatics in the QUT Design Lab, Brisbane, Australia. He is also an ACS Fellow and ACM Distinguished Member with a long-term research focus on interaction design and sustainability. Marcus currently leads the More-than-Human Futures research group at QUT. Together with Dr Sara Heitlinger and Dr Rachel Clarke, Marcus is currently editing a new book for Oxford University Press on *Designing More-than-Human Smart Cities: Beyond Sustainability, Towards Cohabitation*.

Alexandra Crosby is an internationally recognised scholar and visual communicator in the Faculty of Design, Architecture and Building at the University of Technology Sydney. Her current body of research is focused on more-than-human design and recombinant ecologies in urban environments. Here, she explores the relationships between plants and people, revealing the systems and ecologies that will be critical to overcoming the impacts of climate change on our cities.

2.3 Planned outcomes

The workshop will produce an account of participatory/co-design methods for addressing the SDGs. The discussions and findings from the workshop will be captured in the form of a manifesto highlighting challenges and opportunities around designing smart over a distance for sustainable communities. This manifesto will provide the basis for a follow-up publication. The authors have a Special Issue proposal accepted in the Urban Planning Journal, entitled "The Role of Participatory Planning and Design in Addressing the UN Sustainable Development Goals". The Urban Planning journal is a highly regarded Q2 journal. Selected participants from this workshop will be invited to submit an article, thereby sharing experiences and expertise and building bridges between "designers from a distant world".

REFERENCES

[1]   Allam, Z. and Dhunny, Z.A. 2019. On big data, artificial intelligence and smart cities. *Cities* . 89, (Jun. 2019), 80–91.
[2]   Caragliu, A. and Del Bo, C.F. 2023. Smart cities and the urban digital divide. *npj Urban Sustainability*. 3, 1 (Jul. 2023), 43.
[3]   Davis, H., Hespanhol, L., Farmer, J., Fredericks, J., Caldwell, G.A. and Hoggenmueller, M. 2017. Designing Participation for the Digital Fringe. *Proceedings of the 8th International Conference on Communities and Technologies* (New York, NY, USA, 2017), 321–324.
[4]   Davis, H., Waycott, J. and Schleser, M. 2019. Digital storytelling: designing, developing and delivering with diverse communities. *Managing complexity and creating innovation through design*. Routledge. 15–24.
[5]   Fredericks, J., Foth, M., Davis, H., Caldwell, G.A., Parker, C. and Tomitsch, M. 2022. Designing Smart for Sustainable and Resilient Communities: The Role of Participatory Design in Addressing the UN Sustainable Development Goals. *Proceedings of the Participatory Design Conference 2022 - Volume 2* (New York, NY, USA, Aug. 2022), 223–226.
[6]   Fredericks, J., Parker, C., Caldwell, G.A., Foth, M., Davis, H. and Tomitsch, M. 2020. Designing Smart for Sustainable Communities: Reflecting on the Role of HCI for Addressing the Sustainable Development Goals. *Proceedings of the 31st Australian Conference on Human-Computer-Interaction* (New York, NY, USA, Jan. 2020), 12–15.
[7]   Hespanhol, L., Davis, H., Fredericks, J., Caldwell, G.A. and Hoggenmueller, M. 2017. Digital Outreach: Designing Technologies for Diversity, Participation and Social Inclusion. *Proceedings of the 29th Australian Conference on Computer-Human Interaction* (New York, NY, USA, 2017), 648–650.
[8]   Hespanhol, L., Davis, H., Fredericks, J., Caldwell, G., Hoggenmüller, M. and Farmer, J. 2018. The digital fringe and social participation through interaction design. *Journal of Community Informatics*. 14, 1 (2018), 4–16.
[9]   Hodson, E., Vainio, T., Sayún, M.N., Tomitsch, M., Jones, A., Jalonen, M., Börütecene, A., Hasan, M.T., Paraschivoiu, I., Wolff, A., Yavo-Ayalon, S., Yli-Kauhaluoma, S. and Young, G.W. 2023. Evaluating Social Impact of Smart City Technologies and Services: Methods, Challenges, Future Directions. *Multimodal Technologies and Interaction*. 7, 3 (2023). DOI:https://doi.org/10.3390/mti7030033.
[10]   Olinger, J. 2015. *Transforming Our World: The 2030 Agenda for Sustainable Development*. HUMAN.
[11]   Paay, J., Taffe, S. and Pedell, S. 2023. Building relationships with remote participants through playful technology interactions in online codesign. *International Journal of Technology and Design Education*. 28, 1 (2023), 77–99.
[12]   Parker, C., Yoo, S., Lee, Y., Fredericks, J., Dey, A., Cho, Y. and Billinghurst, M. 2023. Towards an Inclusive and Accessible Metaverse. *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems* (New York, NY, USA, Apr. 2023), 1–5.
[13]   Yigitcanlar, T., Kamruzzaman, M., Foth, M., Sabatini-Marques, J., da Costa, E. and Ioppolo, G. 2019. Can cities become smart without being sustainable? A systematic review of the literature. *Sustainable Cities and Society*. 45, (Feb. 2019), 348–365.