From Home to Housing: Designing Smart Home Care Ecologies

Renxuan Liu
The University of Sydney
Sydney, Australia
renxuan.liu@sydney.edu.au

Yiying Wu
The University of Sydney
Sydney, Australia
yiying.wu@sydney.edu.au

Sophia Maalsen
The University of Sydney
Sydney, Australia
sophia.maalsen@sydney.edu.au

Li Zhang
Tongji University
Shanghai, China
liz116@tongji.edu.cn

Heather A. Horst
The University of Sydney
Sydney, Australia
heather.horst@sydney.edu.au

Zixuan Wang
The University of Edinburgh
Edinburgh, United Kingdom
melody.wang@ed.ac.uk

Melisa Duque
Monash University
Melbourne, Australia
melisa.duque@monash.edu

Pengcheng An
Southern University of Science and Technology
Shenzhen, China
anpc@sustech.edu.cn

Dezijian Zhou
The University of Sydney
Sydney, Australia
dzho0167@uni.sydney.edu.au

Abstract

Smart home technologies increasingly promise support for domestic care. Yet, related research typically treats the setting where care takes place—*the home*—as a stable container for interaction, neglecting the broader and changing ecological conditions that make care arrangements feasible or fragile. This workshop reframes smart home technologies as infrastructures of care situated in domestic ecologies spanning home, house, and housing. Addressing these requires an interdisciplinary perspective that bridges HCI, interaction and service design, human geography, and design anthropology. We invite participants from these areas to examine (1) coordination as ecological care work across actors and infrastructures, (2) temporality as care continuity in non-static ecologies, and (3) the need for a shared understanding of the smart home technologies in domestic care from different disciplines. Participants will co-produce an open resource pack: a cross-disciplinary glossary, mapping canvases, and trajectory patterns that surface critical elements of domestic care ecologies and design opportunities for future smart home design.

CCS Concepts

• **Human-centered computing** → **Ubiquitous and mobile computing**; *Collaborative and social computing*; Human computer interaction.

Keywords

smart homes, domestic care, infrastructures of care

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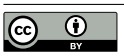

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1 Background and Motivation

1.1 Smart home technologies as socio-technical care arrangements

Smart home technologies are increasingly woven into domestic life with care-related promises: supporting ageing in place and independent living [30, 33, 34], assisting childcare and family learning [2, 14, 35], and coordinating household routines [36, 42]. HCI has correspondingly produced rich accounts of these technologies as part of domestic care arrangements [32]. These studies show, for example, how the use of these devices is often achieved through multi-party coordination among family members [15, 28, 42]. They also reveal that when breakdowns occur, extensive domestic labour is involved, such as lightweight modifications [40], troubleshooting [8], experimentation [34], and repair [20, 21, 31]. And these care-related deployments are often entangled with concerns about privacy, security, consent, and trust [4, 5, 32].

Building on these sociotechnical accounts of coordination, domestic labour, and embedded value, a key limitation remains: the infrastructural and institutional conditions that keep smart home technologies workable are often treated as background context rather than a primary object of research and design. We argue that it is not only devices that shape domestic care, but also infrastructures and other ecological elements such as dwellings and their material constraints [7, 24], tenure arrangements [10, 24, 37], building governance [24, 27], and platform dependencies [24, 25, 39]. These conditions determine who can install, maintain, remove, or rebuild smart home systems, and under what circumstances. For example, a fall-detection sensor may function perfectly, but become useless when a renter is not allowed to drill into walls, or when a building manager requires devices to be removed during an inspection. Also, a voice assistant may coordinate reminders for a child until other family members change accounts, a platform policy shifts, or a service provider shuts down. These conditions

are constitutive of what *good care* looks like, and how coordination is expected to provide it in practice.

What is more, even when studies attend to sociotechnical dynamics, *the home* is often implicitly treated as a stable container for interaction [6, 9, 44] and ignores what happens when surrounding infrastructures change. This move quietly assumes what is, in practice, the hard part of domestic care: stable housing, reliable internet connectivity, available support when things break, and actors able to continually absorb maintenance work. In other words, domestic care cannot be fully understood by looking only at devices or interactions within the stable *home*; it requires attention to the wider and changing ecological conditions that enable (or undermine) care in practice. Therefore, to make them visible and designable for the smart home design, we call attention to an ecological lens.

1.2 Call for an ecological perspective

While HCI has discussed ecologies around smart home technologies, the term is often used to describe device ecosystems (e.g., interoperability, coordination across products, and platform coupling) [41–43]. Our working definition of ecologies shifts attention to the wider and changing relational, spatial, and institutional care conditions, including household composition, dwelling layouts and spatial boundaries, and wider housing arrangements such as tenure, rental rules, and property governance. Together, these conditions shape what residents can install, modify, and maintain, and how care is organised and distributed.

In this workshop, we use *domestic care* to refer to a broad set of everyday caring practices through which people sustain their bodies, relationships, and household life. It includes (but is not limited to) aged care [16, 19, 23, 26], childcare [11, 13], self-care [22], pet care [18], disability support [3], and routine care of domestic environments, like energy management [12]. And what counts as *smart home design* in this workshop goes beyond device features to include ecosystem configuration, services, and platform policies, and consideration of the housing and governance arrangements.

Therefore, to better understand and design future smart homes for domestic care, drawing on design, human geography, and anthropology, this workshop calls for an ecological lens organised around three analytical dimensions: home, house, and housing. Here, from a *home* perspective, care is organised through domestic relationships, expectations, and negotiations among dwellers. Household composition is rarely stable: a newborn arrives, parents visit to help, or paid caregivers rotate. These shifts rework everyday care routines, privacy boundaries, and responsibilities, which often require people to re-coordinate what support is needed and who is responsible for providing it.

From a *house* perspective, care practices are shaped by the dwelling's material and spatial conditions, such as room layouts, acoustics, and lighting, which can enable or frustrate care in mundane but consequential ways. For example, checking on an older adult at night may depend on the connectivity of devices and internet, but these are all constrained by the dwelling's spatial and environmental arrangements, such as sightlines and safe pathways.

From a *housing* perspective, care is conditioned by tenure, governance, and service dependencies that determine what kinds of care arrangements can be sustained. In rental housing, short leases may discourage investment in setting up support; routine inspections can constrain what residents can install or keep; and service dependencies (policies and provider continuity) can abruptly destabilise previously workable care configurations, making arrangements temporary or even infeasible.

Through this ecological lens, our workshop invites HCI researchers, designers, human geographers, anthropologists, practitioners, technology vendors, and policy makers to attend to the following three themes:

Theme 1: Coordination as domestic care work across actors and infrastructures. When we foreground ecologies, coordination no longer means that a user operating a device, or even family members negotiating in a shared space. Instead, coordination becomes distributed across heterogeneous actors (like co-present and remote, human and more-than-human) and the interdependencies of infrastructures, including device vendors, policies, and network base stations. For example, when the new smart control panel is introduced, the new caregiver might avoid using the complex system and instead coordinate care through handwritten notes or messages. Similarly, when tenants move into a new apartment with smart home devices, coordination is needed not only with new roommates but also with the new spatial arrangements. Therefore, from an ecological perspective, domestic care involves a process of ongoing coordination among different actors and infrastructure within and beyond the home.

Theme 2: Temporality as care continuity in a non-static domestic ecology. An ecological perspective also requires a temporal consideration, because, as we mentioned, domestic ecologies are not static. This matters for care because care is not a one-off service or a sequence of isolated tasks; it is everything that we do to maintain, continue, and repair our world [38]. Over time, care arrangements require reassembly: what begins as a workable setup can drift when a new caregiver joins, or when devices must be dismantled and rebuilt after moving. Housing dynamics also intensify this temporality: lease renewals, restrictions on drilling or wiring, changes in utility arrangements, or provider churn can abruptly force reconfiguration. Thus, temporality is a key aspect in the continuity of care arrangements as ecologies co-evolve across home, house, and housing.

Theme 3: An interdisciplinary dialogue is needed to build shared concepts. Many elements of this ecological account have been discussed across disciplines, yet they are often framed through different research traditions and views, and foregrounded differently [17]. HCI has rich discussions for analysing interactional coordination work between humans and devices, while other fields like human geography and design anthropology attend to domestic relationality, dwelling materiality, tenure, governance, and market ecologies as constitutive conditions of domestic life. We therefore call for an opportunity that can align these viewpoints through shared concepts and analytic tools.

Building on human geography scholarship that conceptualises housing as an infrastructure of care, we treat housing arrangements, governance, and everyday material conditions as constitutive of how care can be organised in domestic life [29]. We also draw on Maalsen's account of the smart home in rented and shared dwellings, which shows how smart home devices and digital platforms can be central to everyday caring practices, and can even

enact a digital infrastructure of care [25]. Finally, feminist care scholarship reframes care itself as an alternate infrastructure, directing our attention to the everyday, often non-institutional spaces and collectives through which care is sustained [1]. In this workshop, we therefore use infrastructures of care as a working concept to represent the relational, material, and institutional conditions that enable, or constrain care in and around domestic life.

2 Goals and Activities

This one-day workshop brings together researchers and practitioners across HCI, interaction and service design, human geography, and design anthropology to collectively develop ways of analysing and designing smart home technologies as infrastructures of care within heterogeneous domestic ecologies. The workshop is organised around three linked goals to respond to the previous proposed themes: (1) developing a shared vocabulary that can travel across disciplines, (2) producing mapping methods that make ecological care conditions visible and actionable for smart home design, and (3) attending to temporality as continuity of care, so that the design of smart homes is understood alongside evolving ecologies, like shifting households, dwellings, and housing systems.

2.1 Workshop goals

G1. Build shared language across disciplines. The first goal of our workshop is to develop a shared, cross-disciplinary vocabulary for describing smart home care ecologies (home/house/housing) and their key terms-in-use (for example, care, maintenance, infrastructure, home, governance). We will produce a shared glossary derived from participants' position papers and cases, designed to promote cross-disciplinary communication and to support further design practices. Each entry will include: (1) a plain language definition-in-use, (2) a boundary note that clarifies what the term includes and excludes in this context, and (3) a design use note that states how the term helps designers interpret smart home care ecologies and what it suggests to design for.

G2. Produce mapping canvases for ecological analysis and smart home design. A second goal is to develop mapping canvases that make ecological care conditions (the relational, spatial, and institutional factors that enable or undermine a care arrangement) visible as design-relevant dependencies and constraints. This mapping will operationalise three analytic layers: home (relations, responsibilities, norms), house (layout, thresholds, material constraints), and housing (tenure, rules, governance, service ecologies). Each map will end with a short design translation section that records: (1) key dependencies and constraints (what must hold, and what limits care service), (2) the smart home elements involved (devices, services, accounts, data/permissions, and platform dependencies).

G3. Reframe temporality through co-evolutionary trajectories. The third goal is to produce trajectory templates that reframe temporality as care continuity by tracing smart home technologies and their co-evolution across domestic ecologies (home/house/housing) and identifying critical moments that force care reassembly and make temporality actionable for future smart home design. Each trajectory will include: (1) a timeline across 1, 3, and 5 years, (2) a set of critical moments that stress-test feasibility (for example tenancy rule changes, platform becomes mandatory, inspection, subscription ending, caregiver change, moving), (3) notes on how these changes reshape actors' expectations, adaptation work, and possible abandonment of smart home technologies, and (4) a set of design opportunity statements for smart homes.

2.2 Pre-workshop engagement

Participants will submit a short position paper or case note, or an equivalent portfolio or video-style contribution. Each submission will be reviewed by at least two organisers using the same criteria: relevance to domestic care and smart home, clarity of the case, contribution to cross-disciplinary dialogue, and potential to enrich workshop outputs. Organisers will share accepted submissions in a private repository in advance and set up an online communication channel (e.g., Slack) and a collaborative board (e.g., Miro) to centralize materials, templates, and optional pre-discussion.

2.3 Workshop plan

We plan a one-day, in-person workshop with up to 20 participants across 8 hours, with 1 lunch break. We open with a brief introduction around 30 minutes from the organisers, and align on key working terms (including home, house, housing, and infrastructures of care). We then introduce the day's three goals and its outputs and explain how each activity feeds into the next. Then, each participant gives a concise lightning talk grounded in their submitted case (2 minutes talk). As a group, we cluster cases into shared themes in advance to seed later group formation.

Activity 1: Keyword clustering and glossary writing (supports G1) Participants work in small groups formed around themes drawn from their lightning talk cases. Each participant contributes two to three keywords (for example, maintenance, autonomy, consent, tenancy, visibility, repair, infrastructure). Participants in each group discuss how the terms are used across disciplines and write definitions-in-use. For each term, groups add one design note explaining how the term can support smart home design work. At the end of activity 1, groups share back in a brief gallery round, and organisers compile the glossary draft.

Activity 2: Care scenario building and ecology mapping (supports G2). Each group selects two to three terms from the glossary and uses a Smart Home Care Ecologies design toolkit provided by the organisers to assemble a concrete care scenario. Inspired by Maalsen's notion of smart home assemblages [24], the toolkit provides curated cards to scaffold both scenario construction and ecological analysis: (1) starter cards for scenario seeding: actors (e.g., older adults, children, visitors, roommates, landlords, care workers, pets), devices (e.g., smart speakers, smart toilets, robot vacuums, smart kettles), and care-related activities; and (2) layer-specific prompt cards organised by home-house-housing to surface visible and invisible tensions in the scenario. In the mapping phase, groups map their scenario across three layers: the home layer captures relations, emotions, responsibilities, expectations, and negotiations; the house layer captures material and spatial conditions such as layout, thresholds, cables and device placement, internet provision, plumbing constraints; and the housing layer captures institutional and governance conditions such as leases/tenure, regulations and inspections, building governance/property management, and service

ecosystems. The mapping asks what enables care, what constrains it, what role smart home technologies play (e.g., proxy, coordinator, gatekeeper, workaround, burden), and who bears the work of making technologies function across the ecology. The output is a set of annotated care ecology maps that highlight opportunities, frictions, and dependencies for smart home design from an ecological perspective.

Activity 3: Co-evolution trajectories with critical moment prompts (supports G3) Groups select one care scenario from Activity 2 and, building on its ecology map, explore how devices and corresponding domestic ecological elements may change over time. Organisers provide a small set of critical moment prompt cards from the toolkit to introduce plausible shifts, for example, a tenancy rule change, a platform becomes mandatory, a subscription ends, an internet plan changes, or an inspection occurs. Using these prompts, groups develop short co-evolution trajectories across three horizons, for example, 1 year, 3 years, and 5 years, attending not only to device changes but also to shifts in relationships, responsibilities, spatial and material conditions, and housing governance. They discuss how these changes may reshape actors' adaptation, maintenance work, negotiation, or abandonment of smart home technologies, and articulate who bears the work when care continuity must be sustained across a changing ecology. Groups then formulate brief design opportunity statements grounded in the identified critical moments and dependencies. Where useful, groups create one or two quick provotypes to illustrate future design opportunities, such as a sketch, storyboard, or service touchpoint, that can be shared in the closing gallery walk.

3 Organisers

Sky Renxuan Liu is a PhD candidate in Design at the University of Sydney. His research interests stand at the intersection between design for care and emerging technologies in the domestic context. Drawing on design anthropology and human geography, his PhD project focuses on the smart home technologies in ageing in place.

Bow Yiying Wu is a Lecturer in service/social design at USyd. Her research features participatory and care-oriented design, with a current focus on exploring how technology and service innovations can support care work and care workers. She has rich experiences in organising workshops at ACM conferences on the topics of care technologies and design fiction methodologies.

Sophia Maalsen is an Associate Professor in urbanism at USyd. She is currently researching how the translation of computational logics and technologies is being applied to 'hack housing' and address issues of housing affordability and innovation, as well as looking at the potential role of technologies in tenant advocacy. Her research is predominantly situated at the intersection of the digital and material across urban spaces and governance, housing, and feminism, with particular interest in the digital mediation and reconfiguration of relationships across these spaces. Sophia is currently co-editor-in-chief at the International Journal of Housing Policy.

Li Zhang is a Professor and Design Theorist at Tongji University. Her work conceptualizes design as a normative, world-making practice under contemporary techno-social conditions. She integrates design philosophy, AI ethics, and the production of design knowledge, advancing a theoretical agenda rooted in Chinese social realities while actively engaging with global scholarly debates. She currently serves as co-editor of The Design Journal.

Heather A. Horst, FAHA is a Professor of Design Anthropology at USyd, Australia. A sociocultural anthropologist by training, she researches material culture, mobility, and the mediation of social relations, through the study of homes, clothing, and technology. Her publications include *The Cell Phone: An Anthropology of Communication; Digital Anthropology; Digital Ethnography: Principles and Practices; The Moral Economy of Mobile Phones: Pacific Island Perspectives; and Digital Media Practices in Households.*

Melody Zixuan Wang is a PhD candidate at Design Informatics and Advanced Care Research Centre at the University of Edinburgh. Her doctoral research explores the methodology for designing with and for care in everyday later life, with a focus on tangible technology and ageing-in-place.

Melisa Duque is a Research Fellow at the FUTURES Hub at the Emerging Technologies Research Lab, Monash University. Her works sits at the intersection of Design Anthropology, Participatory Design and Everyday Design. Melisa is particularly interested in two areas of research. Designing for revaluing, and design for intergenerational and ageing wellbeing.

Pengcheng An is currently an Assistant Professor at the Southern University of Science and Technology. His research resides in the intersection of design and human-computer interaction, focusing on assisting and enhancing learning, education, children and their families, and underprivileged groups through the design and implementation of interactive systems in real-world settings.

Dezijian Zhou is a PhD candidate in design at the University of Sydney. His research focuses on the role of technology in supporting social connectedness among older adults.

4 Outcomes

This workshop will produce design insights and resources for designing smart homes as infrastructures of care situated in changing domestic ecologies. After the workshop, we will consolidate the materials produced across the three activities, including a shared glossary, annotated care ecology maps, co-evolution trajectories, and optional provotypes, into a zine that captures definitions-in-use concepts, care enabling conditions and constraints, and how smart home technologies are positioned and reworked across changing domestic conditions. The zine will translate cross-disciplinary discussions into an accessible format that can be shared publicly and with the academic community after DIS 2026. At the same time, we will continue refining the Smart Home Care Ecologies design toolkit based on the workshop discussions and artefacts, and develop it into an open online resource, including prompt cards and mapping templates, to support designers, researchers, and practitioners in analysing and designing smart homes through an ecological lens. To sustain cross-disciplinary exchange, We will maintain a workshop Slack to support post-workshop resource sharing and follow-up publication collaborations.

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