



University of
Pittsburgh

School of Computing
and Information

Dissertation Defense
Doctor of Philosophy in Computer Science

“Smarter Spaces: Designing Automated Systems for Public, Shared Spaces” by Andrew Xu

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Time: 1:30 to 4 p.m.

Place: 6106 Sennott Square, 210 S Bouquet St, Pittsburgh PA 15260

Committee:

- Jacob Biehl, Associate Professor, Department of Computer Science, University of Pittsburgh
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Abstract:

The rise of powerful models and ubiquitous computing has enabled the widespread deployment of smart space technologies across both public and private environments. These systems promise to make the built environment more adaptive and efficient by providing rich spatial insights. However, the benefits of such technologies are rarely distributed equally among stakeholders: building managers and administrators gain actionable information about space utilization, while the occupants who generate that data seldom experience tangible benefits. For many, the perceived advantages of sensing are overshadowed by concerns about privacy, surveillance, and a lack of control, and the very systems designed to enhance human–building interaction risk alienating the people they aim to serve. This inequity threatens to erode public trust and reduce engagement within shared environments, undermining the long-term success of smart spaces. This dissertation develops a framework

for equitable human–building interaction across three stages. First, I designed and evaluated an end-to-end sensing platform, SUPER, that captures insights into space use while adapting to user-defined privacy preferences; I show that its identity-obscuring visual representations retains sufficient information for low-cost automated heuristics to recover occupancy and group configurations. Second, through focus groups and observational study, I examined how occupants perceive these environments, revealing a pervasive resignation to surveillance and a diminished sense of belonging that constrain equitable space use and that transparency alone does not resolve. Third, building on these findings, I co-designed interface features with occupants to reflect their privacy and control needs and evaluated these designs in situ to examine how interacting with them shapes user agency and behavior. I found that the co-designed features gave occupants a greater sense of control over how they use public spaces, and, in turn, a greater willingness to occupy and socialize within them. Together, these contributions establish a framework for equitable human–building interaction, positioning smart spaces not as passive surveillance systems but as participatory environments that empower their occupants.