"What are your thoughts on this place?": A Novel Approach to Living Lab Engagement and Evaluation

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Abstract

Building occupants have little agency in changing the spaces they work and live in, but workspaces are dynamic and heterogeneous, servicing a set of occupant needs which evolve over time. Prior work [6] has positioned access to building data as being useful in negotiating comfort issues, but we are interested in a) the new ways data can be appropriated by building occupants in co-creating the spaces they use daily, and b) how managerial evaluation of buildings might take into account the needs of occupants. This workshop paper presents the design concept for *SpaceBot*, a Twitter bot which provides an interface through which changes can be suggested by occupants, discussed, and implemented by building management. Tweeting smart-buildings represent a potential new mode for Human-Building Interaction, and living lab environments which prioritise the "living" element.

Introduction

Smart buildings create huge amounts of data, but there is a question in the ways this data is used to determine or negotiate the usage and make-up of building spaces. In investigating this challenge, we envision a design concept through which building users can engage with their space more freely, both in terms of changing the

Figure 1: Existing engagement of the estates management team with students and staff on-campus via Twitter

Figure 2: The Urban Sciences Building at Newcastle University. A Living Lab building designed to the BREEAM Excellent standard.

physical attributes of that space and in examining the role building data might have in negotiations of its use.

We conceive that Twitter (https://twitter.com/) can be leveraged as a tool for the co-creation of building spaces in a bottom-up configuration by building occupants. Twitter has received wide attention within HCI research: a microblogging platform which has become a significant source of user-generated content, and a mouthpiece and communication channel for organisations. These affordances make the platform a viable feedback mechanism for organisations in the management of their built estate (e.g. as in Figure 1) and allow us to investigate new modes of use for these spaces, as well as novel ways in which building feedback can be collected and made accessible to building and departmental managers.

The building we examine in this work is a university campus building newly opened in September 2017: the Urban Sciences Building (Figure 2). The building houses 200+ academic staff and researchers, and has capacity for 750+ students. It was designed from the outset as a Living Lab: an affordance which enables this study, as data collected from Building Management Systems (BMS) and services is openly available to researchers. We foresee potential in this to engage occupants and management in their negotiation processes [5]. Our interest in newer data-augmented buildings was piqued by a question asked following our Ubicomp 2017 presentation of our work on auditing using retrofittable sensor toolkits [10]: what approaches might make sense for new buildings, where there is a huge amount of data logged through BMS?

Related Work

Building managers are highly engaged in evaluating and improving occupant experience within buildings. Post-occupancy evaluation (POE) [3] is the industry standard evaluation method, using surveys [7] (e.g. the BUS methodology, & Likert-scale based questions) to gather feedback from building users which can be of utility in designing future building projects. Occupant satisfaction forms just one item [4] in a range of criteria the industry (and industry bodies, for example BRE) has developed in standards to measure and evaluate new buildings. Newer, more inclusive building standards are beginning to be adopted, such as the WELL Building Standard [9] which re-frames the built environment with a focus on occupant health and wellbeing. Such methodologies are highly structured, but we foresee novel ways of gathering qualitative data which could be used in combination with standards through unstructured technology-mediated discussion.

In motivating our design, and in demonstrating why a Twitter bot for co-creating and evaluating buildings is an interesting concept, we outline a few previous uses of Twitter in HCI literature. Twitter has been leveraged as a means for increasing involvement and participation: co-constructing lecture material [2] in an educational setting; as a methodology for conducting online research surveys [1]; as well as in more traditional applications e.g. as a customer service chat-bot [12]. In terms of sustainably-focused projects, the TweetDrops visualisation [11] raised awareness of sustainability issues, and EnergyBabble [8] presents the use of an artefact powered by tweets (among other data) to investigate discourse around sustainability practices in small communities in the UK.

Interview Themes

Expectations: Common expectations included that the design would dictate if spaces were successful (or not), and that usage would be as-designed. As new settlers in the building, it was expected that this will be discovered over time.

Adversariality: Staff used adversarial language to talk about negotiating different groups' requirements, positioning the University, student body, and Estates service as sometimes having conflicting needs & motives.

Mechanicism: Staff conceptualised the building and the organisation as a mechanism: component parts working to create the whole.

Neoliberalism: Common to all staff was an understanding that the University operates as a business, supplying a service to users/consumers. This has implications for how students are framed, and how facilities are managed.

Methods

We conducted initial interviews with four key management stakeholders, which informed the design direction we have taken with SpaceBot. The motivation for this was in finding out how managerial staff conceptualise building space and its evaluation, and generating an understanding of which aspects of building use should be addressed by our study. We hold that our stakeholder-interview methodology was a valid way to inform this design (as opposed to, say, participatory design with building occupants) as co-creation and evaluation of spaces go hand in hand: within an organisational structure, change can only be effected through a carefully managed process involving multiple actors who seek to ensure the building is running according to their set of evaluation criteria.

Our interviews were transcribed and the corpus thoroughly coded using a lens-based coding approach. Our chosen lenses were:

- *Existing Practice*: How things are done/happen
- *Space & Place*: Space construction/perception
- *Position & Power*: How occupants (students, staff) are viewed by management

The theming of our ~600 codes revealed themes around *expectations, adversariality*, *mechanicism* and *neoliberalism*. These themes generated findings which informed our design concept: these are summarised in the sidebar.

Technology Design

The following section outlines the design of *SpaceBot*: a Twitter bot that provides a forum for occupant discussion of the Living Lab building, backed by data generated by its BMS. Importantly, our design is enabled by the fact that management in our target building were highly interested in gathering feedback to inform changes to the space. A Twitter-based agent is therefore a good way to explore this.

While our intention is to code and deploy some realisation of this concept in future, we intend to first explore and develop it through a series of design fiction workshops, promoting discussion of interfaces which enable ongoing interactions with a smart-building. We outline possible interaction methods, connecting them to motivations from initial research, and define what can be captured about interactions which can be of use for facilities managers in evaluating the building.
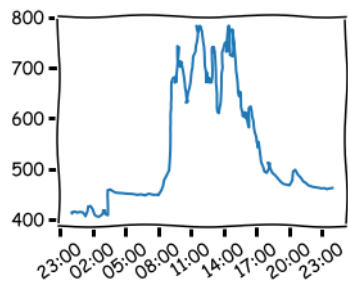
SpaceBot

Our preliminary work revealed how managers conceptualise their practice in relation to our building, and the infrastructures and processes in place for managing its spaces and the people within the
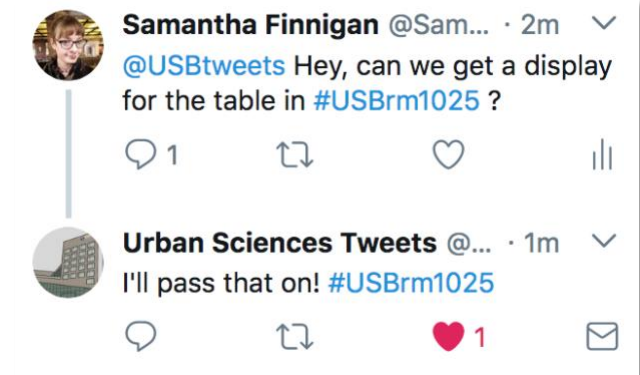
Figure 3: An example of an interaction with SpaceBot

Figure 4: An image macro / meme. In making our Twitter bot more playful and relatable to our occupants (many of whom are undergraduate computing students), we can embed image macros in some tweets (where relevant— and where playfully irreverent). Image source: quickmeme.com

Figure 5: A graph generated from CO2 data for an office kitchen, collected from the BACNET BMS network, served to researchers via an API, and graphed using Python *matplotlib* with the xkcd style.

Twitter Affordance	SpaceBot Usage
Mentions (e.g. @SamMFinnigan)	Attracting facilities management attention (e.g. "*Hey @BuildingManager, it's really warm (29.4˚C) in 1.072!*"), or for notifying users subscribed to the bot.
Following (and following back)	Following is a common tactic for advertising a Twitter feed, but should be limited (e.g. to known academics & students) to avoid being treated as spam.
Hashtags (e.g. #LabTweets)	Tagging data as about a particular space (e.g. *#UrbanScience #USBrm1025*), and listening for these tags in order to respond to user queries.
Media (attaching images/video)	Attaching graphs of space data, or even for playful use (e.g. embedding text in image macros & memes).
Polls	Polls can be conducted through Twitter (and can even use a Likert scale) e.g. a user survey: would you prefer X, Y, or Z?

Table 1: Selected design affordances of Twitter, and some potential ways these could be used as part of SpaceBot.

organisation. Our first requirement for *SpaceBot* is to provide a forum for occupants to change elements of their space (Figure 3). It is clear that existing staff conceptions of engagement are from a top-down perspective: the building Tannoy system and the Estates Twitter feed, for example, were both mentioned by interviewees but are designed from a management perspective. Conversely, SpaceBot is intended to provide an open-ended space for discussion, to investigate what factors the building occupants themselves want to be changed (and therefore how these spaces should be evaluated by management).

Data Presentation
The affordances and existing functionality of Twitter affect how it can be leveraged: SpaceBot draws in highly localised building data from sensors (temperature, humidity, CO2 and light, among others) which can be queried through hash-tagged tweets to

the bot. How the data is arranged and can be queried depends on how people can interact with it. For example: graphs can be easily tweeted as an image attachment, but there are challenges in understanding what visualisations might be useful for occupants. The second purpose of this design concept is to investigate this sense-making challenge.

Spatial Hashtagging
in using hashtags for advertising particular space IDs, SpaceBot connects to the spatial layout of the real-world building. Posters in these spaces advertise a unique hashtag space ID (e.g. *#USBrm1025)* which the bot is programmed to respond to. This can be used to retrieve data on a space, or specify where changes should be made. These posters are augmented using a BLE beacon, which advertises a URI link to tweet at the *SpaceBot*, with a notification which appears on the phones of people within the space.

Conclusion

We have described our design concept for *SpaceBot,* a technology which we intend to use as a *design fiction* in an upcoming study into the co-creation and evaluation of living lab building spaces, exploring the relationship between physicality of space and building data. Our concept promotes a two-way negotiation: promoting agency in changing space for building users, while gathering feedback for staff to be used in building evaluation and space improvements. Co-creation of space subverts the current market focus of building management, where occupants are considered "users". We view combining social media based interaction with living lab based building data (given the existing use of the platform by organisations for communication and feedback) as a novel approach to the management of building spaces, with potential to democratise creation and curation of the built environment.

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