Mapping Disagreement around Smart City devices

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Abstract. This paper is a preliminary report of a long-term participant-actor ethnography following a Smart City mobile phone app that is part of a EU research project. The study uses an actor-network theory approach to follow the app and via interviews with the app designer and observations of the EU research project, argues that these technologies are surprising human/machine hybrids whose main qualities are their affective affordances which enrol large numbers of users. The paper tracks a number of contradictory framings and uncovers ontological disagreement about what the app is sensing. Smart City technologies have not been black boxed yet, and are still at the stage of performing as affective hybrids that need to enrol actors. This means that the networks around Smart Cities are still malleable and it is still possible to critique existing tools and to develop new models and forms of agency for Smart City technologies.

Keywords: Smart Cities, Internet of Things, Actor-Network Theory

I. 'SMART' CITIES

A. Smart Infrastructure & Smart Citizens

The terms Smart Cities, Internet of Things & Ubiquitous Computing are related concepts that are often used interchangeably to describe the pervasive introduction of technologies such as sensor networks into cities and the wider environment. Examples of Smart Cities that are often cited in the literature are the newly built city of Songdo in South Korea [1] and the technological transformation of Singapore [2]. An article from the official Chinese News Agency [3], claims that by 2015, China will be investing $159 billion into Smart Cities. The innovation that is seen to be making these cities 'smart' is the technological linking of individual components into a network that mediates data & services between governments, companies, individuals and the environment. Many of the visions of Smart Cities, are being proposed by global technology companies who envisage themselves building these cities through partnerships with governments. In IBM's vision, "*almost anything--any person, any object, any process or any service, for any organization, large or small--can become digitally aware and networked*" [4].

In the Internet of Things [5], a particular focus is placed on the routing of sensors and actuators that allow cities to be managed as an 'Integrated Operation System' [6, 7]. Individuals, institutions and infrastructure are tightly meshed together, with all the entities generating as well as receiving data. Key to this vision is the smart phone, which is seen to be changing from a "*communication tool to networked mobile personal measurement instrument*" [8]. These technologies of Participatory Sensing [9] enable people to gather environmental data to improve governance and place a renewed focus onto the user. While most of the Smart City rhetoric focuses on infrastructure, there is also an emerging discussion on 'Smart Citizens' [10], where technologies are "*empowering people to become true change agents*" [8] as well as transforming themselves to "*alter the subjectivity of contemporary citizenship*" [11].

B. Conceptual Approach

The approach of this paper is not to accept or attack these visions of Smart Cities but to empirically examine their claims in relation to the material forms they take. What kinds of material practices do Smart City technologies create? To guide this research, this paper adopts the approach of Bell & Dourish [12]. They argue that from ubiquitous computing's earliest visions by Mark Weiser [13], that the technology has always been a future promise that is just around the corner but never reached. Bell & Dourish suggest that the way this powerful vision is presented as close by, yet indefinitely postponed, encourages hyperbolic language while preventing any analysis of the current impacts of the technology. They argue for the need to critically analyse ubiquitous computing as it exists now as 'ubicomp of the present' [12] rather than waiting for a realised state which will never be reached. In their paper they examine examples from Singapore and Korea and identify 'messiness' as the key quality of ubiquitous computing. They argue that contrary to the hype, "*infrastructures remain messy after decades or centuries, as the user of any transit system from urban subways to international airlines can attest*" [12] (p. 140).

The messiness they identify is complex and multi-layered, including technical variability, ecological impacts as well as cultural misunderstandings and power differentials between stakeholders. This overlapping messiness of human, technical, legal and environmental issues requires a broader conceptual framing. This paper uses actor-network theory [14]; [15], to understand this 'messiness' as a an 'ontological messiness' which blends human and technology into hybrids. Latour calls this space where humans and non-humans mix the 'middle kingdom' [16]. According to Latour, these hybrids challenge modernism, which responds by trying to purify entities as either society or nature. This paper examines how hybrids are dealt with in Smart City contexts, in particular who is trying to build them and who is trying to purify them. In Callon's 'sociology of translation' [17], hybrids are built through processes of translating the interests of human and non-human actors into shared agendas and enrolling them to form networks. By watching these chains of translation and enrolling it is possible to identify power dynamics in the networks. Marres extends this approach with her notion of 'material participation' [18], which charts processes of enrolling people via sensing devices into forming hybrids such as eco homes. Material participation is seen as political through the way it transforms neoliberal policy framings of ecology into material practices that shape the everyday lives of participants. Marres identifies the 'performative flexibility and 'political variability' of these technologies which allow simultaneous co-articulation of economic, participation and innovation agendas. This paper is guided by this notion of material participation in the context of an ethnography of a Smart City device.

C. Introducing the WideNoise App

The case study of this paper studies the EU funded FP7 research project EveryAware [19], which is focused on participatory sensing tools that are designed to collect environmental data as well as monitoring changes in the behaviour of users. This paper follows one of the tools from the EveryAware project, the WideNoise mobile phone application [20]. The app allows users to take geo referenced sound level measurements and send them to a server where they are mapped and displayed for all the users. The company WideTag [21] first developed WideNoise as a free iPhone application in 2009. In 2011, a later version of the software was licensed and customised by the EveryAware project and used for research with users. In 2013, the software was bought outright as WideTag ceased trading. The app is currently publicly available as a free and open source application for the iOS and Android platforms. Since the purpose of the application is disputed and explored in this paper, the best way to introduce it to the reader, is via the description used on both the WideTag and EveryAware websites: "*WideNoise will help you to better understand the soundscape around you & live a healthier life*" [20, 22].

Beyond this shared tag line, the two websites frame the app rather differently. The WideTag company describes the software as "*a very simple application that could be scaled efficiently and do some load on our WideSpime infrastructure*" [23].

In contrast, the EU research project describes it as an "*instrument to address the issue of noise pollution that allows the compilation of reliable pollution maps as well as the monitoring of the evolution of people's awareness about environmental issues*" [24].

The aim of this paper is to try to understand what kind of changes were made to the app in this transition and how different framings of the app might suggest deeper ontological conflicts in Smart City technologies.

II. METHODOLOGY

A. Ethnography of Infrastructure

This paper uses actor-network theory as a methodology for following the WideNoise app. In particular it uses Star's 'ethnography of infrastructure', to "*attend ethnographically to the plugs, settings, sizes, and other profoundly mundane aspects*" [25] of technical things. The apparently trivial aspects of technology are the material conduits that physically, socially and legally connect actors across different scales. By watching a user bend down to plug in a device, they are using technical standards that allow the plug to fit the socket as well as legal & commercial relationships that allow electricity to flow from the national grid. Bruni adapts this approach to identify and track hybrid actors, by "*letting the software guide me through the organisation and confront me with other actors and processes, whether human or artificial*" [26].

This approach gives technical devices the role of guiding the researcher through the case study and doesn't presuppose, who or what might be a relevant actor. Lash describes that this transforms the role of the researcher from a mediator that 'explains', to a 'materialist pathfinder' [27] that follows and maps the paths of devices. This paper involves following a mobile phone app and describing pertinent waypoint encounters on its journey from design, usage with participants, and the framing of the data by the EU project. The paper uses first-hand observations and semi-structured interviews to highlight different understandings of the app along its journey. The paper presents four radically different framings of the same app that seem to be coexisting at the same time.

B. Dual Role of the Researcher

Where this study departs from a classic actor-network ethnography, is that the author is both an ethnographer and actor in the case study, being an official EU researcher attached to the UCL team, as well as carrying out a multi year ethnography for his PhD. This paper is a preliminary report of this ethnography, focusing on only a small number of actors from the larger case study. The dual role allows special insights into the process of the EU research project and means the author is physically and emotionally engaged in the dynamics of the case study. This raises issues of objectivity and ethical consideration in relation to professional distance. The situation requires an action research model which combines first, second and third

person approaches [28], that allow & require personal reflexivity as well as writing in the first person. Since the aim of this ethnography is to follow a number of technical devices, the need to collect and disclose personal information on informants is minimised. All the participants in the study have given their consent to this research and have been anonymised and names changed.

III. Different Framings of WideNoise

A. WideNoise as Tactile-Affective Infrastructure

The first stop on the journey of WideNoise, is at the WideTag company, which was founded in Italy in 2008, and later moved its headquarters to California, where according to an industry website it became one of the "*main movers and shakers in the emerging Internet of Things*" [29]. Like many other tech start-ups they had a 'chief evangelist', who gave talks at new technology forums and were written about in the populist technology magazine, Wired. In addition to technology audiences, WideTag also sought to engage large mainstream audiences through TV interviews in Italy and a listing in the New York Times' 'Top 10 Internet of Things Products of 2009' [30]. In the mission statement on WideTag's website they describe a thriving Internet of Things, where "*mobile devices enable unprecedented ease of distribution and adoption for software of any type. As devices are now interconnected and location-aware, digital services provide an opportunity to integrate computing use into a 24 hour lifestyle. WideTag takes advantage of this opportunity to sell applications and hardware extensions that radically enhance the users' experience with their surroundings*" [31].

When I interviewed Mario, who designed the WideNoise application, a more nuanced picture emerges: "*we started discovering there were a lot of people [...] working on the Internet of Things, working on a lot of activities but all the pieces in the puzzle were kind of held at the research stage. So there weren't any standards to allow peer-to-peer communication. And [in] this process we are developing quite a big platform called WideSpime to collect a huge amount of small chunks of data - of course sensor data and then they said how do we show this to the world? How do we demonstrate the platform itself?*".

A contrast emerges between the picture of a thriving Internet of Things ecology, and one where all the hard work of building the infrastructure remains to be done. The reality in 2009, was more like the Wild West with no coherent protocols for the Internet of Things and many different companies competing for who would be able to build the standard that would become known as the Internet of Things. In the interview, Mario suggests that the genesis of the WideNoise application was an attempt to demonstrate the abilities of their WideSpime platform. WideNoise "*was the visible part of the underlying platform. If I come to you and say we have this huge amazing platform that is able to collect millions of data-points per second. You will say ok, what does that mean? If I come to you and show you a software application, and the iPhone is in hype, it helps a little bit. I show you the application. I measure the data. I see a data point on the map [...] So for us the first version was really a proof of concept. This is the kind of thing our platform allows us to do on a global scale*".

The WideNoise application started life as a tangible mock-up of an Internet of Things service that would convince clients of the abilities of the WideTag platform. The main requirement of the app was to generate lots of load on the WideSpime server by sending lots of data. Mario explains that the choice of sensor was guided by technical utility: "*What kind of sensor does the phone have? Well the light sensor, yes it's not really easy to get. So the only really one that was feasible, was the sound, the microphone*".

In this framing by the WideNoise designer, the app is a technology demo for marketing purposes and built according to the material affordances of the smart phone. Yet things are not as simple, as the next extract of the interview shows:

Mario: "*We were trying to engage the people, [...] if you are taking a measurement, its because you want to see what is the sound level in this room. But if you want to see the sound level in this room you really don't particularly care at that specific moment where is that located on the map [...] That is, why we didn't block the application to wait for the GPS signal because if you block you just wait ok. Its not yet there. And you just want the measurement. Instead [...] we just get the measurement and you get the best out of it as quick as possible, we get a large amount of data. Yes, some data is not as good as others but we still get a lot of amount of data and as a user you get immediately the information you want*."

Researcher: "*Did you get lots of people using it straight away?*"

Mario: "*Yes well, no. It's kind of a niche product. So, the numbers are still not the millions that you get usually. In the new spot, we still had a quite a good response. I think that on average in the first two years we had roughly about 100 downloads per day. Roughly that way. So we reached some top 10 charts around the world. For us that is quite impressive*".

This extract demonstrates the way that the WideNoise application requires massive amounts of users to be engaged by the app and the way it conflates masses of users with masses of data. Without the masses of users that are behind the scene generating data-load the tech demo would not work. In that context, it is interesting to follow the logic of the design decision not to block the user while the GPS of the smart phone has no location lock. Mario argues, that the option to sacrifice accurate geo-location is also shared by the users who 'just want the measurement'. Apparently the user aims coincide with those of WideTag who want the largest amount of low quality data. The 'user' as envisaged in the WideNoise app is not a human being with any autonomous goals. Rather they a tactile mass of finger presses and thumb swipes.

In contrast to the arbitrary choice of sensor, the app designer was very careful in developing a 'steam punk' visual aesthetic for the app, with elaborate icons of a sleeping cat, a dragster and a T-Rex dinosaur to represent the noise levels. The WideNoise users are only fingertips hovering millimetres above the mobile phone screen, needing to be enticed to interact by smoothly sliding interface screens and icons. From the WideTag perspective, WideNoise tries to function as a tactile-affective hybrid that blends human and machine by engaging and enrolling masses of users into generating lots of data and thereby legitimising their technology platform. In a recursive fashion, it is only by successfully seducing large numbers of people to use the platform, that it comes to exists and become infrastructure. Without users, WideNoise is just an algorithm on a solid state disk, yet by enrolling enough users, the WideSpime platform might have become the default standard for Smart Cities. In this vision of technology design, the central aim is to build tactile-affective interfaces that can predictably entice user into forming hybrids with the technology.

B. WideNoise as Tool for Issues of Concern

In 2011, the WideNoise app was licensed by the EU research project EveryAware. The way I was introduced to the app was as an instrument for creating noise pollution maps. This framing coincided with other noise mapping projects that the UCL team had carried out with local residents to target a scrapyard and an airport. The role of the UCL team within the EveryAware research project was to recruit and engage as many people as possible to download and use the WideNoise application. The expectation of the research project had been that thousands of users would be recruited and different recruitment methods compared. Since the app was presented as a noise-measuring instrument, and due to the experience of the UCL team, we chose to piggyback on the existing issue of noise around Heathrow airport. We focused on the activists group HACAN, who oppose expansion of the airport and campaign for further noise regulation. We raised additional funding outside of the EU project to be able hire a member of HACAN as a community officer, whose responsibility was to interface with local residents around Heathrow and to help them to use the app. HACAN used their mailing list to invite their members to come to workshops where we trained local residents near Heathrow to use the WideNoise app. In later discussions with a senior representative of HACAN, I was surprised to learn, that he didn't actually think that the participatory noise measurements would uncover anything new about the noise problem around the airport. HACAN had agreed to collaborate because they felt the WideNoise app would excite many of the residents to take part and thus demonstrate the level of local concern. In addition, they felt that the association with UCL would bring publicity and legitimacy to their political cause. In Latour & Callon's notion of enrolment & translation [14, 17], one actor tries to subtly persuade another to depart from their usual way of doing things. In this case study, the enrolment was more complicated, mutual and materialised by the app, which became the focus point for the chain of translations. The app displayed aspects of a 'boundary object' [32], which allows groups to collaborate whilst holding contrasting understandings. This case study suggests that in addition to the material object itself, it was the notion of enrolment and participation, which was, shared between HACAN the UCL team. Both parties had a shared goal of trying to enrol people into building powerful representation without any clear distinction between human, machine or environment. At the project launch, a local councillor gave a speech proposing that the app "*will enable people to, [pause] real people to record, real noise, not what Heathrow or what anybody else says it is - real people record real noise and put it on a map*".

The extract creates equivalence between 'real' people and 'real' noise and presents the hope, that the app can combine human and environment into a hybrid that is more truthful than the official representations. This framing presents WideNoise as a political/affective hybrid for building powerful arguments about noise as both culture and nature.

C. WideNoise as Scientific Instrument

While the EveryAware research project benefited through the collaboration with HACAN by access to lots of users, it also entangled the research into a political context. While for myself and the other UCL researcher, this coincided with our own personal positions; it created some discomfort for the other EU project partners. Tensions surfaced at a subsequent project meeting, when we reported back that the majority of the users framed WideNoise in political terms. In the pre-project survey, some of the users wanted to "*raise the bar for politicians thinking about the 3rd runway*", while others wanted to demonstrate emotional impacts by bringing "*greater recognition of impact of noise especially the frequency of interruption by planes*". Only a small number of participants perceived the project as scientific data collection. When these findings were presented, a number of the researchers described their fears, that the biased group of participants might be polluting the data purity. In this vision of the project, the goal should have been to enrol thousands of users without any agenda and entice them to generate 'neutral' data about the environment. The EU project teams consisted of four different knowledge cultures: environmental scientists, physicists involved in social dynamics modelling, computer scientists and the UCL multidisciplinary team. The key point for the environmental & computer scientists, was that in order to make accurate noise maps of the geographical area, they would require enormous amounts of spatial and temporal data coverage and to control as many variables as possible. This meant that WideNoise users should be required to walk repeatedly backwards and forwards across the same stretch of road at many different times of the day and night to produce 'reliable' pollution maps. This envisaged WideNoise users as automated noise monitoring stations that need to be calibrated. As one of the slides of the EveryAware presentation put it, the goal was to 'turn people into sensors', which would purify WideNoise as an instrument for measuring

nature. The most revealing moment emerged when the UCL team decided to test the technical quality of the WideNoise app. The application running on multiple phone platforms was tested against a Class 1 reference device at a sound laboratory. The results showed very large variation in readings between the mobile phones and the reference device, with differences as large as +-20dB(A) between the different phones. That magnitude of variation showed that there had been little to no attempt to calibrate the software as a sound meter. WideNoise also did not measure dB(A), which is the standard frequency weighting used to approximate human hearing. For me this raised ethical issues, since we had already enrolled many users into using the app to monitor their environmental concerns. I hoped that by showing participants our test results, that we would be able to rebuild a trust relationship with the Heathrow participants, even if it lead to a dramatic reduction in app usage. Yet, I was deeply surprised how the participants in Heathrow reacted. They were not surprised or angry at the app. For them, WideNoise had never been an accurate scientific instrument but a way of materially and politically engaging with the frustration of the planes flying over their heads. As I found out later, even with a low accuracy device, it is possible to do effective local politics based purely on the strength of user numbers and the disruptive blending of subjectivity and objectivity inherent in the design of the WideNoise app. When the same test results were presented to the EU partners they were also not surprised and said that they had always know this. In the transition of the app to the research project, WideTag had only added a number of interfaces slider as well as cosmetic changes to make it look more 'professional'. "*While the old rusted style was in many ways a trademark that distinguished WideNoise 2.0, we decided for the research project to go through a full redesign and make it more like a professional tool, with a sheer metal surface and orange lights*" [23].

The environmental scientists were frustrated with the application because no improvements had been made to the underlying sound measuring algorithm in the transition to the research project. As an uncalibrated number generator and lacking any inbuilt monitoring protocol, WideNoise made for a poor scientific instrument. This said, none of the researchers wanted to try and calibrate WideNoise, which they argued would take considerable technical effort.

D. WideNoise as Perception Changer

In the transition from WideTag to the EU research project, WideTag had been asked to add a number interface additions and to release the software as WideNoise 3.0. In particular, the research project had requested a basic form of 'gamification' [33], to be added in the form of a slider and decibel number, which appear when a user tries to take a sound reading. Instead of immediately displaying the measured noise level, the slider delays the user and encourages them to guess the level of sound by dragging the slider towards the right to alter their decibel guess.

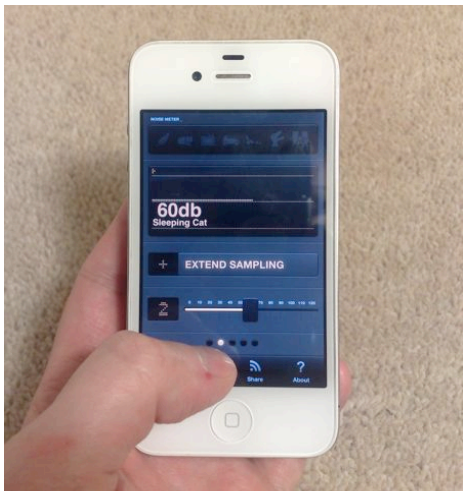

Fig. 1. WideNoise user guess set at 60dB.

After the measuring period of 5 seconds finished, the screen displayed the user's guess next to the 'correct' number measured by WideNoise. The two values are compared and the user encouraged by displaying the word 'good' if the numbers are close or 'no Match' if there is a big difference.

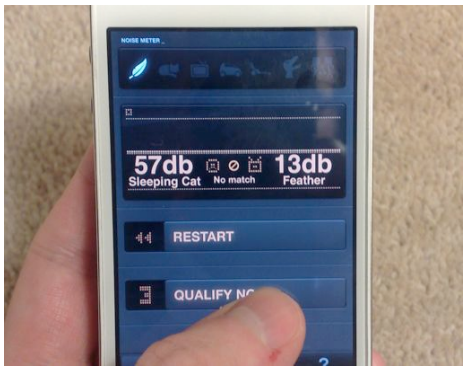

Fig. 2. The screen displays 'No match', due to the difference between the 57dB user guess and 13dB app measurement.

While I was working with residents around Heathrow with the application, many said they never noticed the slider, or those that had seen it were confused as to what it was for. The social dynamics modelling physicists had a dramatically different understanding of the slider. For the EU project review meeting, they had created a diagram plotting all the user guesses vs. the measured noise level. In the diagram, a 'correct' user guess, would line up on the diagonal connecting the lower left to the upper right. They argued that since not all the points lined up on the diagonal, "*users are not fully aware of the acoustic pollution around them*" [34] (p. 37). In addition they examined individual user guesses over the duration of their usage of the app. In the diagram, light-grey circles correspond to the app being used for the first time, while dark circles correspond to guesses made at a later time.

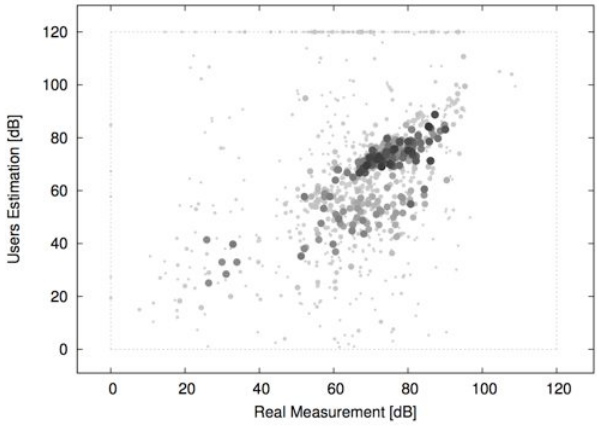

Fig. 3. Diagram of WideNoise user guesses vs. measurements. Taken from the EveryAware EU report on modelling social dynamics [34] (p.38).

The suggestion is that over time, users were moving closer to the diagonal and that users "*improve their awareness by using the application*" [34] (p. 37). The report uses the language of gaming to suggest that users were changing from novices to experts. The project report to the EU argues that this demonstrates "*that users can act as sensors, if properly trained, and can provide a[sic] reliable acoustic monitoring of the environment. As a side effect, users acquire awareness on environmental issues*" [34] (p. 37).

This conclusion polarises the WideNoise/user hybrid in terms of objectivity and subjectivity. Despite clear evidence of the technical inadequacy of the application for measuring environmental noise, the machine's guesses are seen as the objective standard against which the user's subjective guesses are measured. Any discrepancy between these numbers is then shown as visual feedback and used to re-calibrate the user's awareness to shift them closer to the device's guess. This framing of how the slider and visual feedback combine to affect the users seems similar to a computer game. The proposal that by training the user's slider reflexes, the user is also reaching an awareness of environmental issues is a bold one. Beyond the activity of creating a data point, WideNoise does not provide the user with any contextual material about noise pollution or other environmental issues. The mode of user address appears to be tactile-affective rather than cognitive and differs from the genre of 'serious games' [35], which often involves the user in problem solving. The question of what problem the WideNoise app is solving seems a pertinent one. The framing the physicists present is as a testbed for opinion modelling where the aim is to monitor the effects of new information on voting behaviour. This linking between micro behaviour and macro patterns changes the scope and expands the potential impact of WideNoise. During the Antwerp meeting on one of the team leaders suggested that with the app, "*people can learn their perception*". This raises the question, whether by training people to express their personal experience in terms of decibel numbers, these users become enrolled into a wider framework of governance? Foucault's notion of 'governmentality' describes distributed neoliberal governance where individual citizens are trained to internalise messages into their own everyday lives in order to discipline themselves. Foucault talks about the special role technologies play in this process, in particular 'Technologies of the Self', which allow people to carry out a "*certain number of operations on their own bodies and souls, thoughts, conduct, and way of being, so as to transform themselves in order to attain a certain state of happiness, purity, wisdom, perfection, or immortality*"[36].

This framing presents WideNoise as a micro and macro training technology that rationalises citizens and make them more predictable in the ways they express their feelings about noise via officially sanctioned numerical standards. Whilst many of the Heathrow participants used decibel as a framing for their experience, this appeared to be a symptom of the pervasive technocratic framing of noise, and not a result of WideNoise usage. In fact the technical issues of WideNoise and lack of measuring protocol seemed to open up the black box of noise and encourage discussions amongst the residents about finding alternative metrics for their experience. So, whilst the app seems to offer a latent script for self-disciplining, the material reality and usage of the app in Heathrow do not fully align with this.

IV. Conclusions

In this journey guided by WideNoise, we have seen a large variety of different framings of ubiquitous computing. We have moved from WideNoise as a tactile-affective infrastructure that needs to enrol masses of users in order to come to exist, to WideNoise as a political tool used to demonstrate issues of concern with little regard about whether it senses culture or nature. With the environmental scientists, we saw a failed attempt to purify WideNoise as a scientific instrument that could speak about the environment. With the physicists we saw an attempt to purify the human part of WideNoise and to re-train it to become more 'environmental'. We have seen a single technical device going through a complex chain of translations across competing agendas whilst continuously generating disagreement about what is being sensed. Throughout, the journey, the app has remained lively in its own materiality, with its tactile visual interface, lack of sound calibration and subjective slider - denying total capture by any of these competing framings. WideNoise seems to display a 'performative flexibility' [18], a kind of openness towards different models of participation that allows these antagonistic but overlapping networks to coexist simultaneously. The main commonality that all the different understandings share is a belief in the app's affective power to entice large numbers of actors to participate and create data. These large datasets seems to act as boundary objects that allow the different actors to be compartmentalised and allow the contradictory framings to coexist without any explicit conflict.

Taking a broader view, the question arises whether WideNoise is representative of broader realities and

trends within Smart City technologies? If seen as an isolated smart phone app, then it is easy to dismiss this case study; yet if seen in terms of the networks WideNoise gathered together, then the case study speaks about the agendas of a broad group of actors building Smart Cities. If we thus accept WideNoise as a legitimate example of ubicomp of the present, then we need to question what will happen when it is built into the kind of 'Integrated Operation System' that will run our cities? The kind of 'ontological messiness' that WideNoise displays will challenge modernist attempts at governance. Current political institutions seem ill equipped to deal with trying to clarify the boundaries between human and environmental standards. Furthermore, how will citizens be able to contest the quality of political and environmental governance created by these hybrid technologies? With people being turned into sensors, sensors are being treated as citizens. Sheppard argues that 'Sentient Cities' are contested sites where "*long standing claims of essential human qualities, capabilities and characteristics are critically destabilized through their attribution to non-human actors*" [37]. This blending may have the effect of undermining claims to human rights and questions the basis for future agency in Smart Cities. It is possible that Smart City ontology will lead to a 'parliament of things' [38], where humans and non-humans such as rivers get to speak equally, but it may equally enable a libertarian paternalism where human/sensor hybrids are 'nudged' [39] into behaviour change.

Based on this preliminary WideNoise case study, it appears that Smart City technologies have not been black boxed yet, and are at the stage of performing as affective hybrids that need to enrol actors. This means that the networks around Smart Cities are still malleable and it is still possible to critique existing tools and develop new models and forms of agency for Smart City technologies.

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