Data Walking in the Unheard City: Sampling Infrastructured Devices with Mobile Apps

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Increasingly connected devices and things create new relationships between humans and devices that invite questions about infrastructuring, or the process through which these links come into being and are maintained (Korn et al., 2019). These create an ecology of physical and digital relationships that emerge as infrastructure (Star and Ruhleder, 1994). This paper presents preliminary results of the Unheard City project that engages with devices using the Bluetooth Low Energy (BLE) protocol with an Android phone. The application draws from data ethnography with sensors (Nafus, 2018). My contribution uses the methods to explore infrastructure and its infrastructuring. I introduce the app supported data walk before using the results of app supported data walks to reflect on the socio-technical infrastructures that are detected on the Bluetooth signals and the technological literacies required to both read it (Parks and Starosielski, 2015).

The app is a digital participant that records Bluetooth or BLE signals and WiFi as well as location to provide a simple route map. The app is started at the beginning of the walk and closed at the end. The data is removed from the devices and processed on other machines.

Initial results suggest two forms of infrastructure that can be read as patterns. Firstly, there is a hardware infrastructure made up of physical systems, such as lights and routers. The second, a software-defined infrastructure is defined by the application used to control the devices. In the first, it might be possible to discover links between the devices, such as lights and routers, that react to our presence and their manufacturers. This work suggests that further steps to use the company identifier to explore the available software applications to interact with the devices and the infrastructures that arise: who maintains the infrastructure? A second model comes forward: modelling the relationships between devices within a company to understand their interactions. A museum's controllable lighting may be linked to a router, itself accessed by software applications. The local hardware infrastructure is controlled by software made by another company.

Covid beacons, still detectable, demonstrate a particular health infrastructure. A protocol defined by Apple and Google, the beacon acts as privacy preserving way of communicating a status between devices and health care systems. The infrastructure, and its privacy preserving features, for the service is provided by two phone operating system providers. This model is a largely human out of the loop that centralises the mobile platform within this health infrastructure. It does rely on humans entering test results, but otherwise the system relies on phones and APIs to operate. Through both examples, the Bluetooth hardware infrastructure can join the Internet either through the Web or mobile infrastructures.

I see these as raising challenges in technological literacy. The data is derived from signal data and the protocols needs to be understood and modelled. A challenge is reading the signal data itself. The advertised presence provides services that can appear at certain temporal moments. Possibilities for the connections use a reading of the manufacturer field or name within the results. The phone supports a localised view of the digital world (Loukasis, 2019) with the data placing into a wider set of global relationships. Sociograms (Shadbolt et al, 2019)

are developed to include the political and timing aspects of the data assemblage (Kitchin and Lauriault, 2014).

The connections arise from a shifting set of relationships that are made available through the interaction of devices. The limiting of the app to BLE means that only a small sample is being created where other protocols can be sampled. The signals suggest ways of exploring the world based on attributes such as providing a service or otherwise as well as by classification of the device based on the manufacturer or other data, where the latter are indicative of relationships. The device may also advertise itself at set periods of time and may not be captured within the sampling period. The set periods and possibilities of connection are defined by the manufacturer. This manufacturer separation of networks suggests two representations: one from the manufacturer perspective of many devices in one localised space or a person whose data is divided between multiple manufacturers.

These raise the question of the who provides infrastructure to study these infrastructures. These turn us towards questions about what these methods allow us to explore (Marres and Gerlitz, 2015). Using mobile applications places this work into being a tool to reflect on its own coming into being. This centralisation of the phone is a key issue to using mobile devices, in understanding how they allow the following of protocols. Android operates as a platform that enables access to the underlying hardware and to process the responses that is structured by the designers, either through interfaces or permissions granted. These permissions, and what protocols and signals that are present, change over time and contextualising these changes is a topic of future work. Using the sensor APIs allows us to interact with the processed radio signal and how the operating system orders and structures the device results though their ordering and the classes used to interact with them. A review of the permissions being added and deprecated suggest an increasing focus on different signal types and changing permissions that warrant further research into the politics of Android as a platform for infrastructure research (Gillespie, 2010).

Using digital methods to explore infrastructure raises challenges for technological literacy and understanding the method's positioning within the work. Future work will augment the software-defined data infrastructure as well as linking it to company that provides the software. Workshops and further modelling are required to support the development of a toolkit to analyse and represent the received data. Future versions of the application will capture more protocols to enhance the existing capabilities.

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