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Data Narratives: Aesthetic Activation of Urban Space Through Augmented Reality

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Chapter 8
Data Narratives: Aesthetic Activation of Urban Space Through Augmented Reality

Conor McGarrigle and John Buckley

8.1 Introduction

This project has its origins in Namaland, an AR artwork by Conor McGarrigle from 2010. At that time, AR seemed to be on the cusp of a breakthrough, moving from a marginal technology of interest to pioneers, specialist users and artists chasing that moment of emergence of a new technology. Coming off the critical and aesthetic innovation of locative media and the explosion in ubiquitous mobile and location-based technology, we were, according to best estimates, perhaps six months or a year from the killer app that would propel AR into everyone's pocket as an indispensable tool to augment our mobile-first world. This breakthrough did not happen, which is not to say that AR technology went away or failed to advance, but it did not enter the mainstream in a significant way even as the cell phone colonized all aspects of everyday life. Today, while surveying the current state of the art in AR, the sense of déjà vu is strong. Once again AR is on the verge of another breakthrough in maybe six months down the line, a year at most, but this time, it is for real. The top technology companies in the world, Apple, Google (Alphabet), Microsoft and Facebook (Meta) have bet big on the metaverse, and along with virtual reality, AR is part of this extended reality (XR) future. We are living in what Paul Dourish and Geneviève Bell back in 2004 described as the proximate future, an in-between time where the upgrade is almost within reach in a Gibsonian act of redistribution of the assets, knowledges and customs of the future. The project in question for this chapter followed a break in this artist working with AR technology in their creative

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practice. On returning to the medium previous mobile-based platforms familiar from this period as the pioneers and likely leaders of the AR wave had fallen by the wayside through acquisition, failure, mission pivots and exhausting funding without successfully monetizing their platforms. Two developments seemed to have changed that; Apple's *ARkit* and Google/Alphabet's *ARCore* in conjunction with Unity's 3D software development kit which together offered a powerful suite of methods and tools that, in combination with the increased processing power and sensor and camera capabilities of the latest generation of cell phones and mobile devices, have enabled a more sophisticated and precise augmentation of space with a broader range of media and data. While these SDKs have afforded powerful app-based AR infrastructure increasing the reach of AR applications, they have commensurately increased the learning curve and resources needed to create AR applications, thus reducing the opportunities for real engagement from artists and hackers without access to requisite resources. The exceptions to this trend have been the recent advent of fully featured development tools aimed at creatives with limited coding ability such as Facebook's *Spark AR Studio* and Snap's *Lens Studio* which have lowered the barriers to access while strictly confining the outputs within their respective walled gardens.[1]

This chapter situates itself within this evolving context with an account of the development process for an artistic AR project that arose from a residency programme in a research environment that looked at city dashboards and urban data.

8.2 The Programmable City Artist in Residence

The project arose from a period as artist in residence with the Science Foundation Ireland funded Building City Dashboards research project, a project that saw its origins in Maynooth University's ERC funded Programmable City research project (Kitchin 2021, pp. 69–78). The project had begun by building a prototype of a Dublin Dashboard, an accessible web dashboard that presented key indicators of the functioning of Dublin city drawn from sources of open civic data. Based at Maynooth University under the direction of Rob Kitchin in conjunction with Dublin City Council, the project developed the Dublin City Dashboard (Young, Kitchin and Naji 2021) while researching the broader implications of city dashboards and civic open data. The artistic residency programme directed by Maynooth University Professor and artist Jeneen Naji invited artists to create a digital artwork using open data from the Dublin and/or Cork dashboards.[2] The goal was to 'explore and expand multimodal creative expression in the digital space using open urban data and to extend the work of the dashboard visualization and the public impact of the

[1] Despite this, these tools have enabled a wave of high quality critical creative outputs orientated around AR filters demonstrating that these constraints are not anathema to critical creative work, see for example the curatorial practice of Zaiba Jabbar https://www.hervisions.world/

[2] See http://www.dublindashboard.ie/ and http://www.corkdashboard.ie.

research through an open competition for media artists to research and build alternative data tools, app and representations'. This would be achieved through a period working within the project with privileged access to data, project researchers and expertise built up within the associated project teams of four PIs, eleven post-doctoral researchers and eight PhD students with partners including Ordnance Survey Ireland, Central Statistics Office, Smart Dublin and Smart Cork Gateway. The selected artists were free to work independently with the support of, and in dialogue with, the project team.

8.3 The Spatiality of Data Narratives

The art project initially had three principal objectives: an exploration of urban data with a focus on its relationship with place and its spatiality; uncovering locative data narratives, that is stories that could be told by and through the data that describes the city; and finally delivering an aesthetic experience through augmenting the space of the city in ways that meaningfully relate to the experience of being in the city. These objectives were premised on an acknowledgement that city dashboards are by nature entangled with smart city narratives, but are also instrumental in evolving understandings of the smart city that can be distinguished from early technocratic versions promoted by hardware manufacturers such as Siemens, IBM and HP, to the more nuanced readings of the smart city today (Townsend 2013; Picon 2015). This is allied to developments in critical data studies where the idea that data are neutral and objective, simply reflections of reality that are operationalized in smart systems, has been comprehensively dismantled in recent scholarship, giving way to more wide-ranging accounts of bias and discrimination baked into AI systems traced back to fundamental flaws in the nature of training data (Crawford 2021; Eubanks 2018; D'Ignazio and Klein 2020; Noble 2018). Data, in this reading, are never raw but always already cooked (Gitelman 2013) the result of contingent processes of selection and processing that do work in the world.

The approach followed in the project is additionally informed by an understanding of the city being developed through a European funded research project, *The Real Smart City*,[3] one of our chapter's authors is an investigator on. The data city approach (McGarrigle 2021) is a recognition that the contemporary city is always already enmeshed in data with every action generating and described by data with complex algorithmic processes producing space; leading to considerations, for example, of how data defines the space of the city and is defined by it, how data assemblages are enacted in space and in that process change the space itself, and how data bind all aspects of the networked every day, human and non-human, in the space of the contemporary city. From data footprints to data shadows, digital doppelgängers and

[3] A three-year Marie Skłodowska-Curie RISE (Research and Innovation Staff Exchange) Action Programme led by TU Dublin's Graduate School of Creative Arts and Media and funded under the EU's Horizon 2020 research and innovation programme, grant agreement No.777707.

data doubles, these data form accounts of our embodied presence in the city. They are spatial and relational, bringing together embodied presence and its entanglements with myriad systems that form our everyday lives, from the urban governance of the smart city to personal and public presences of social media to the socio-technical assemblages of surveillance capitalism. Thus, we understand the city and our presence in it by following the data. Even as it follows the data, the data city approach is most urgently concerned with urban inhabitants: where do communities and individuals fit within these technological systems, as data subjects within vast data assemblages that see human activity as a source for data extraction, modelling and nudging, or as critical users with the agency to mould the city and its systems to reflect their concerns and desires? This approach thus goes beyond concepts of the smart city with its focus on city governance and infrastructural emphasis to encompass the pervasive reach of data extraction, from location on cell phones to social media interactions, purchases and consumption and so forth, amid the multiplicitous digital entanglements of urban life.

This is connected to influential activist strands of urban philosophy inspired by the writings of Henri Lefebvre, Michel deCerteau and Jane Jacobs who see possibilities for human agency in the city that can be revealed through focusing on what people do within the urban systems they inhabit, acknowledging that even within pervasive urban technological systems of governance, surveillance and control within the complexity of the city there are always gaps, hacks, workarounds and omissions. The data city approach is to recognize that everything in the city produces and is described by data, moving beyond ideas of the smart city with its infrastructural and governance focus to more intimate and individualized regimes of data capture. The fallacy of data models is that data can describe all aspects of urban life from the most idiosyncratic, whereas in fact these models are reductive approximations of the complexity of lived experience (Amoore 2020; Cheney-Lippold 2017). It is within this context that data are extracted from the practices of everyday life through pervasive digital processes; these data are used to describe and build predictive models (or AI) which are then operationalized in the world through systems that are increasingly recognized as fundamentally biased and flawed (Crawford 2021; Eubanks 2018; D'Ignazio and Klein 2020; Noble 2018). Identifying these flaws and developing methodologies, heuristics and epistemological structures to provide remedies, oversight and new modes of operation is of urgent importance to maintain confidence in data powered systems and, it is recognized, the wicked nature of this problem (Rittel and Webber 1973; Brown et al. 2010) of necessity calls for transdisciplinary approaches of which artistic AR practice are but one small part of this endeavour.

The geographer Rob Kitchin, who with media artist Jeneen Naji conceived of the residency programme at Maynooth University, suggests that telling data stories, 'interconnected stories about how data are produced, processed and interpreted, and the consequences of living in a data- driven world' (2021, p. 8) offers another dimension to how we understand data and its consequences in the world that can support and contextualize more traditional academic approaches. *Data Narratives* follows this idea to ask what happens if our data stories are made visible in space in the places to which they refer; both the stories we tell about ourselves and the narratives by

which we are understood to regimes of planning and governance. Furthermore, the process of making them visible through our digital devices, of rendering them not only visible but locationally specific, through a process of over layering these contextual data layers, is seen to highlight the coextension of place and data. It demonstrates the hybridity of all space as data space, as all data are locational and all locations described by data. Of course, at one level, we are aware of this, but it is, we suggest, another thing to see this specific data materialized through augmented reality in real space. However, unlike the data we are generating through our digital interactions, the data materialized through this artwork do very little other than appearing as reductive descriptions that afford the viewer no agency in interacting, commenting or amending them. They make visible data that are predetermined by processes over which the audience has no control. This is central to the ambitions for the project, to make visible some strands of the data narratives that are told of the city and its inhabitants as data subjects,[4] narratives most often generated without their oversight or input. The details of this initial idea would be determined by the availability of data at sufficiently granular a level so that it would refer to discrete locations and districts, and to identify from this the types of stories that could be told by the data. This was established during the research portion of the residency.

8.4 Working with Data

The objective of the residency was to explore such multi-modal readings of urban data in ways that would make urban data more visible, increase engagement and promote alternative dimensions to these data through a range of approaches, aesthetic, activist and narrative. Through a process of consultation and discussion with the dashboard research team, available data were sifted and explored. At one level assessing it for its narrative value and, at a more practical level, its detail and freshness—there were many data that were sparse and infrequently updated—and availability for use in a public artwork, which effectively excluded much operational data that were restricted for valid reasons of privacy. The decision was made to work with a combination of data sources: fine-grained census data that detailed a range of urban parameters that told of the inhabitants of neighbourhoods in the city of Dublin, locationally specific housing cost data obtained from a variety of sources and collated by Maynooth University data scientists, data scraped from the Airbnb platform by activist website Inside Airbnb, and finally data scraped by the artist from the Twitter API on the hashtag #HousingCrisis geographically constrained to the city of Dublin and environs, revealing an active conversation that was reflective of a range of attitudes to the housing crisis.

[4] In European GDPR the data subject is the legal term for a person whose data is collected and subject to processes of analysis.

The official census data are the gold standard data record of the entire population, detailed down to urban 'small areas'[5] but with a limited number of parameters that included household size, annual income, car ownership, Internet connectivity, nationality and native language. The authors combined this with locational information on housing costs sourced from Daft. A housing rental website that used its listing data to provide the most detailed tracker of housing prices in the city. The objective was to bring together data representations of the city's inhabitants and their changing nature and the ways they are understood at an official level, with this portrait further contextualized by the perspective of a hyper-active housing market that, as it spiralled out of control, impacted on these individual narratives of Dublin; a city still at the time recovering from the worst economic crisis for generations and the humiliation of a Troika bailout. While these data were instructive, they lacked personal narrative. Income brackets and average rents combined with occupation densities allow us to speculate, for example, that in certain areas of the city, the convergence of these factors results in overcrowded accommodation, but they are cold facts that lack emotional traction unless you are personally priced out of a place to call home. In order to supplement these factual data, I turned to another factor widely believed to be implicated in the rent crisis; the property sharing platform Airbnb.

While at this time, 2018, there was little official information on the scale of Airbnb's activity in Dublin or elsewhere, Airbnb was believed to be a significant contributor to the increase in rents and the lack of availability of property to rent; properties that would normally be rented were now achieving a higher return through short term rents of Airbnb. (Harris 2018) I was able to access data from an unofficial source, Inside Airbnb[6] an activist website created by digital storyteller Murray Cox, that detailed the extent of their activity through an ongoing programme of data scraping (Fig. 8.1). While Airbnb maintained that its service was a room sharing service that augmented homeowners' income, these data detailed the number of entire homes available on Airbnb which in August 2018 was more than double the number available to rent; clearly, an unregulated Airbnb was part of the problem.

After some time exploring the Airbnb data, two categories stood out; the property descriptions which typically included a description not only of the property to rent but also the neighbourhood and the 'host' or renter and the 'guest reviews', that is reviews left of specific properties by their customers. These offered an alternative perspective of these rentals, their place in the city and the guests, tourists, visitors and people passing through. On the surface casual and informal but for the reputational economy of the service, a vital part of the mechanisms establishing reputations, not only of the rental but also of the customer, and something of their interrelationships. Or at least, those premised on this commercial relationship even as it presented, in the Airbnb model, itself as a guest and host relationship with most of the reviews coached in these terms. The final component was the data scraped from Twitter's #HousingCrisis hashtag. This data, the text of the tweets, accessed more directly the

[5] Of approximately 80–120 households see https://www.cso.ie/en/census/census2016reports/census2016smallareapopulationstatistics/.

[6] See http://insideairbnb.com/behind.html.

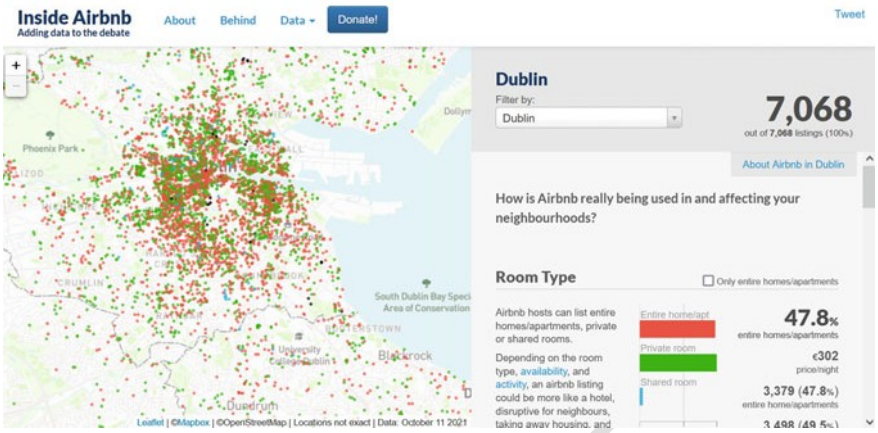

Fig. 8.1 Inside Airbnb mapping of Airbnb rentals in Dublin

visceral anger, frustration and hopelessness of those caught in the crisis alongside a dynamic and impassioned debate on policy and what was seen as governmental inaction. Together, it was hoped, these data sources would reflect limited samples of the flows of data the city was enmeshed in, representing the differing, and often competing data narratives of the city and its inhabitants.

8.5 The Data Narratives App

After some experimentation, it was decided the objective was to build a mobile app that would read the user's location and over-layer a locational specific range of these data (Fig. 8.2), thus augmenting the user's space with several competing and complementary narratives that arise from data. Narratives that it becomes apparent are incomplete, partial, contradictory and subjective but each representative of a perspective—a version of place—that describes and shapes the life world through disciplinary lenses: the city planner, the real estate market, the multi-national giant of the sharing economy. The narrative of the individual living in the city shaped by these forces was largely absent in this fragmented making visible of these narratives, representing the reality of the situation where individual city dwellers voices do not feature prominently in planning housing policy.

After a process of identification and sorting of data points, data were categorized into locational areas—this coalesced into Dublin's local election city wards, small areas averaging populations of 1500–3000 for which detailed demographic statistics were available. For each of the 114 city wards, a data set was constructed with key demographic information: population; household size, number of children, native language, economic indicators such as average house price, average rent, vacant properties, number of full-time Airbnbs, households without Internet, car ownership.

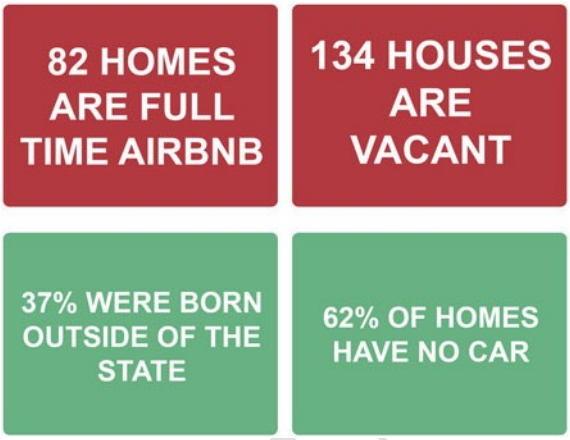

Fig. 8.2 Examples of the data placards that were over-layered within city wards through AR

The final components were the review narratives about the experience of being in these areas from the perspectives of the Airbnb visitors. Each piece of data was categorized into four broad categories; demographic, infrastructural, economic and narrative to be presented as colour coded virtual placards that would provide a digital overlay to populate the augmented perspective of the project's audience once they entered each of the small areas of Dublin's city centre (Fig. 8.3).

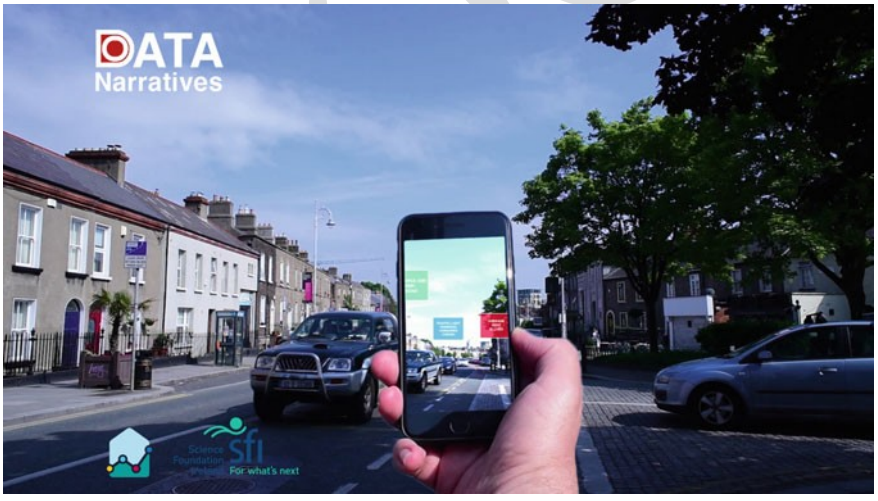

Fig. 8.3 Data narratives app in operation

8.6 AR Development

The development stage of the project coincided with an upsurge in AR tool development and the sense that recent developments in computer vision were emerging from research labs into the hands of developers and artists as useful tool sets. Before Apple's recent entry (at the time) with ARKit and Google's competing offer with ARCore, the only significant development platform was Vuforia, then owned by mobile chipset manufacturer Qualcomm, that allowed for simple image tracking where artists and developers used fiducial tracking markers to track 3D/spatial content. Vuforia's system was relatively easy to implement and had the added benefit of a free licence for non-commercial projects. However, Vuforia at the time had no planar or ground tracking, a feature being heavily promoted by the AR newcomers (ARKit/Core) at the time and one that seemed to be a key asset for this project.

The primary focus of *Data Narratives* was to overlay these data onto placards in specific locations defined by GPS coordinates. However, much like the often-quoted problem of the 'last mile' for fixed line telecoms delivery, GPS suffers from a 'last metre' problem that obstructs accurate placement of AR objects. Although it is indeed possible for a Google Maps hybrid positioning-based placement of the user with a much closer resolution, these are not available to use as they are dependent on position data from cell towers which is only available by costly licencing arrangements. It is interesting to note that whereas GPS positionality is freely available it is not sufficiently reliable in urban conditions, the greater resolution emanating from network carriers is proprietary, raising concerns over locational privacy as with recent concerns over law enforcement dragnet use of Google's Sensor Vault location database. (Valentino-DeVries 2019) Such problems of overcoming the 'walled garden' problem arise time and again for artists working in this field as we will see.

As GPS location is only accurate to within a few metres the possibility of exploring the possibility of tethering placards to specific locations using object recognition algorithms, that both ARKit and ARCore heralded as major innovations, to track off buildings in each area. Whereas it was claimed that object-based recognition could work outdoors, it was found that it was not possible to overcome the limitations of the device camera in an outdoor setting. For example, fast changing lighting conditions particularly under Irish conditions impacted the system's ability to recognize a surface. It was only in tightly controlled indoor settings with an evenly lit subject that the process could be made to work. Moving to generic ground or horizontal plane tracking and floating upright placards gave favourable results as ground plane detection has the added benefit of having the camera fill its field of vision with a relatively stable exposure without blowing out, as you would when you attempt to track anything horizontal that would bring a brightly lit sky or indeed the sun into play. While working well for the data placards, it was less successful for applications that required a greater degree of precision.

A perennial issue for artists and developers working with emerging technologies is negotiating the discontinuities between the development cycles of both Apple (IOS) and Google (Android) platforms. At any one time, either SDK (ARKit or

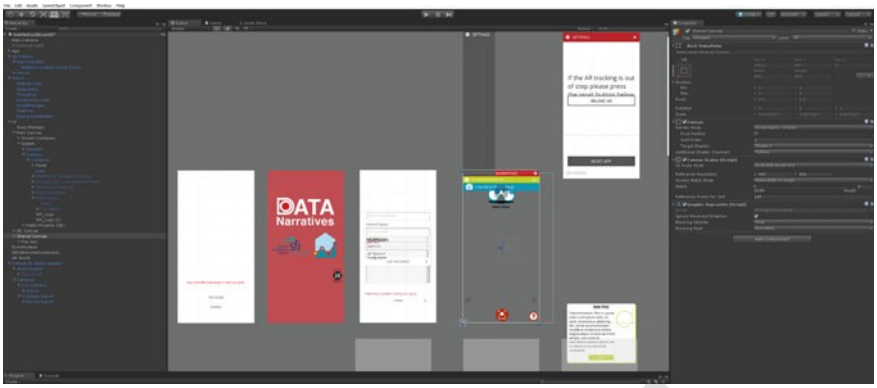

Fig. 8.4 Unity project screen capture

ARCore) may allow certain functionalities not present on another and users must wait until one catches up or even supersedes the other. While clearly driven by marketing exigencies, this adds to confusion and frustration in using these platforms where specific features tied to platforms hampers creativity as it shoehorns artists into forced platform decisions based on feature availability. 3D game engine software Unity has since attempted to overcome these difficulties by releasing its own SDK, AR Foundation, that seeks to be device agnostic, allowing artists and developers to work on a unified library of functions that switches automatically behind the scenes at application build time depending on what device is called for. Unity, as a third-party content creation platform without hardware interests, is uniquely placed to provide cross-platform tools that foreground content creation that is device agnostic. However, while Unity is well known to 3D and game artists, it still represents a complex environment (Fig. 8.4) with a steep learning curve and requires building the results as apps which, in contrast to a previous generation of AR platforms like Layar, is a daunting prospect for many artists.

8.7 AR as Emerging Vapourware

SDKs being offered by Apple and Google was the enhanced ground-plane feature that is the ability to detect flat surfaces in the camera view and to place objects accurately on these surfaces without the need for marker patterns or images. This it was hoped would allow the app to place these videos as augmented overlays so that the speakers would appear to stand on the ground wherever the user activated the video to deliver their location-specific perspective on a one-to-one basis, thus augmenting their space with an interpretative layer that challenged the official version that the government was promoting. AR traditionally has had this ability only in well-lit controlled environments; it will most likely work in an indoor location with a flat surface and good lighting. However, in an uncontrolled exterior space with diverse and quickly changing light sources in addition to uneven surfaces, this ability breaks down in the face of this complex visual scenario. AR applications typically overcame this with marker images, specifically designed images that could be identified as the ground plane allowing the accurate placement of the augmented asset. As the ambition for the project was for a self-guided tour where users could use the app without guidance or specific set-up, it needed to work without the need for specific markers to be physically placed in the real-world space for it to function. After comprehensive testing, we discovered that the ability of markerless ground plane detection promoted by both ARCore and ARKit was in fact vapourware and not available in real world scenarios. The results achieved in testing had the expert video clips appearing erratically depending on the conditions, occasionally working as intended but most often floating above ground plane surfaces in an unpredictable fashion (Fig. 8.5). As the intent of the work was to maximize access to the widest levels of devices, we reluctantly abandoned this aspect of the work with a resolve to revisit it at a later date when the technology would be sufficiently advanced to deliver the promise. This is certainly one of the issues when working with advanced AR

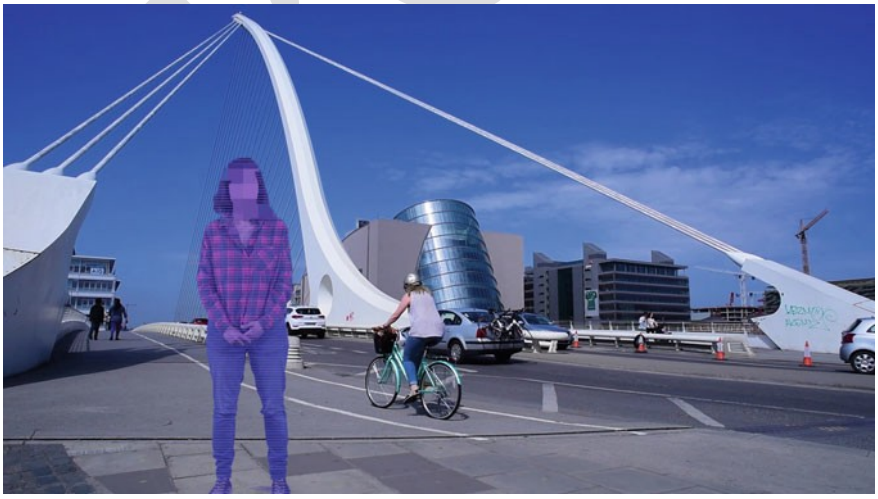

Fig. 8.5 Early test of a video overlaid over camera view

technology, the cutting edge is also the bleeding edge; where contingency impacts at a frequency that we are unaccustomed to in our everyday use of digital technology—particularly cell phones—where the technology has become almost seamless for users who are not early adaptors. With AR what was presented in the marketing communication of the key players was not always reflected in reality, at least not yet. This shift in the work led us to concentrate on delivering a robust work that would work for the broadest constituency of users possible, leading us to refocus on the use of the floating geo-located placards.

8.8 The Aesthetics of Augmentation

As has been argued elsewhere (McGarrigle 2013) AR's ability to overlay real space with a contextual data layer is central to its power as an artistic and activist medium. This epistemological capacity to augment and contest the materiality and understanding of physical space through the introduction of real-time locationally specific instructional, informational, aesthetic, narrative and subversive content is the core of AR's power as an artistic medium. In this work, *Data Narratives*, the audience were presented with a camera view over which a changing selection of data describing their location was overlaid. Each informational placard had a specific geo-location and orientation; thus, appearing relative to each user's position, placards were additionally assigned differing durations once triggered by the app's presence, thus ensuring a dynamic display of information from the range of available perspectives, with the experience being individual to each user and contingent on their physical presence and location. The placards were specific to each neighbourhood providing data relevant to where it was accessed with the display changing from street to street. Depending on viewpoints and position, they were sometimes sparse while in other areas crowded and overlapping with viewpoints competing for attention (Fig. 8.6).

At times, the extent of the data display obscuring the view completely rendering it unreadable as a torrent of only partially comprehended data, while at others, they resolved into clear narratives that were intelligible to the user. While the data displayed in the app were a relatively small data set curated to be representative, once overlayered on to this normal camera view perspective an effect was conveyed of an overwhelming complexity, that in this limited context, the human eye was unable to keep up. Nonetheless, some of the data would register, some impression would be made and a notion of the hybridity of space as an intertwining of both the physical and digital would be presented, however rudimentarily. This is an aesthetic experience that operates at multiple levels; at once, it juxtaposes with our sense experience of everyday life (Saito 2017) with AR reconfiguring our perception of the physical world through visual, graphic, dynamic and conceptual augmentation. However, aesthetics following Rancière can additionally be understood as the 'distribution of the sensible' (Rancière 2009) and thus inherently ethical and political. The aesthetic of *Data Narratives* resonates at this political level that seeks to add to the discourse

Fig. 8.6 Data narratives screen showing overlapping data placards displaying a range of data including Airbnb reviews

on the housing crisis in Ireland in its epicentre, Dublin. It is also a data visualization that seeks to increase engagement with these data sets through novel modes of presentation, and the aesthetics of data visualization also come into play. These aesthetic registers are seen to be complementary of each other, their combination, juxtaposition and interactions in the augmented hybrid space creates the open space of the work to be engaged with by the audience mirroring the competing narratives of the space of the city that are told through myriad data sets.

8.9 Conclusion

Data Narratives is in many ways a prototype, an intervention that points towards a way of working with AR and data, a way of contextualizing space through a process of augmented narrative that has its roots in the work of the locative media movement of the mid-2000s. This chapter has focused on the process of producing the app, from research to technical production and the thought processes that have informed this work. This comes from our background as artists and art educators. As artists we recognise the complexities of working with emerging technologies, where there is often not a clear roadmap for artistic uses of the technologies being deployed. As educators, we understand that the relative difficulties of creating art with a range of tools, platforms and technologies imposes very real practical limitations for our students. With these limitations negatively impacting on the choices they make in their work. While one of the main ambitions of the project was regretfully abandoned when the technology was found lacking, we imagine that this will be possible shortly and will be revisited either by this or a new project. While the

complexities of development were found to be increasingly challenging for artists, certainly in comparison to an earlier generation of AR tools such as Layar, recent advances in browser-based AR libraries such as a AR.js give hope that the next generation of AR will be in the browser, with a lower learning curve and a more open paradigm.

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