The Emergent City (2007- 2017): Artistic explorations of the control and the ethics of data

Tanza, S.

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Artistic explorations of the control and the ethics of data

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Abstract

The PhD by Published Works examines selected practice-based artworks made by the author - the artist Stanza - over a ten-year period. This thesis represents an opportunity to reflect back on a body of digital artworks after they have been made and to re-examine the artworks that were conducted through artistic practice-based research and to contextualise them in an academic framework.

This PhD focuses on selected art projects made in the period 2007 to 2017 but are grounded in work under the title *The Emergent City* developed from the author's AHRC research fellowship at Goldsmiths College, University of London from 2006 to 2009.

The research became an investigation into the ubiquity of real-time data within the city to create new media artworks. The practice resulted from technical investigations via sensor-based inquiry into real-time global observations currently employed via data harvesting technologies which cannot be separated from the artworks made and presented.

This thesis discloses how, through practice-based research, these artworks contribute to the field of new media art by investigating real-time data flows, that simultaneously allow the meaning to be shifted, altered, parsed, and represented back to us, the audience, as art. Furthermore, and in context, the work incorporates inquiry into dataveillance[1], the smart city and the Internet of Things (IoT).

The body of work *The Emergent City* incorporates research based digital artworks which are all in turn investigations into archives of these data that are controlled via bespoke online interfaces, which have been reformed and recounted into real-time experiences, as emergent artworks made by the author. The artworks are not only expressions of ideas that create a rich understanding of complex concepts of the

[1] Dataveillance is the practice of monitoring and collecting online data as well as metadata. Roger Clarke coined the term in 1986, as a contraction of 'data surveillance', and published an analysis of the concept in 1988. www.rogerclarke.com/DV/CACM88.html [Accessed 6. July. 2019]

contemporary issues of surveillance and privacy. They could also be described as technological demonstrators that cross multi-disciplinary boundaries, including art, computing and urban studies.

Through numerous commissions, and research grants, these artworks have in common that they scrutinised the real-time city as a panoptic control system. Over twenty art projects (2007 - 2017) have been made using live real-time environmental data, surveillance and security data that have been presented and exhibited in various galleries worldwide from the Bruges Museum to the V&A and supported by numerous curators, which will be discussed.

Finally, conclusions drawn at the end relate to the possibilities offered to artists by representing city environments with data and how artworks can enable us to critically reflect upon issues concerning surveillance through data-oriented new media artworks.

The projects are all viewable online at www.stanza.co.uk where all these art projects are archived as online interfaces and online visualizations, as well as data-driven dynamic artworks in the form of large scale installations, or sculptural objects.

Note for clarification

All the work in this thesis by Steve Tanza is authored and signed as Stanza. All the artwork mentioned or referenced in this text is by Stanza unless stated otherwise. The thesis is written in the third person presenting a more formal and academic language to the text so that I could distance myself from my work and create a reflective perspective.

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All these projects and artworks are online at Stanza.co.uk[2] and can also be viewed in the offline digital resource Volume 2 '*WEBSITES*'. There is also folder of '*EXAMPLES*' of the working software offline and selected videos and a folder of '*EXTRAS*' containing movies of other artworks referenced in this volume.

Author's Declaration

I declare that all the material contained in this thesis is my own work.

Steve Tanza

July 2020

[2] It is worth noting that a generation has passed since Stanza started making netart in 1994 and from 9th April 2019 most of the online net art pieces will be obsolete as online specific experiences. Shockwave technology under most operating systems and all browsers is officially being made redundant and this was the main technology used by Stanza in exploring the internet as a medium for creative practice. In due course these links and online netart works will be replaced to show screenshots and videos and they will no longer be supported in the online net art context for which they were made. Many of them will be available as exe software for exhibitions and provenance.

1.0 Introduction

The broad research objective is to come to an interpretive understanding of the changing dynamics of city life and the environment through artistic practice. In order to support a wider academic-based methodology, critical texts and online sources will be cited and drawn into the argument to underpin and frame it into a wider contextual framework of online networked new media art with a concurrent philosophical grounding relating to the stated aims of each artwork.

Therefore in analysing the artistic portfolio it is important to reflect on selected historical surveillance texts and references, on new media artists (as well as the author) within this arts practice. The thesis investigates and demonstrates the transition to liquid surveillance (Bauman, Lyon, 2013) thus allowing a wider reflection on and reinterpretation of these digital media artworks in terms of the data-based monitored society we now inhabit. New surveillance practices of tracking, tracing, and sorting are now based on information processing and the complexity of data flows inside systems and within organisations. Surveillance has responded to the '*slippery nature of modern life';* everything is on the move across systems and borders, flowing in perpetual motion, continually monitored.

It is the spaces we inhabit, the landscape, the city, and the world that are ultimately being networked with technology that can parse data informing us where we are and what is happening in the environment at any given point in time. The outputs created are informed by the critical analysis of city spaces using wireless sensors. The research proposition and practice involve creating artistic scenarios (software visualisations and physical art installations and objects) by mixing and evaluating data streams that in reality become virtual connected spaces and might also be considered as a public domain space. Furthermore the practice speculates on future possibilities of connected, open networks by developing this series of artworks under the global title

The Emergent City that are affected in real-time by invisible flows of data. Lev Manovich suggests that the next logical step is to consider the ‘invisible’ space of electronic data flows as substance rather than as a void, something that needs a structure, politics, and a poetics (Manovich, 2006).

It is the data flows that Castells (1996, p.442) refers to as 'the repetitive, programmable sequences of exchange and interaction between physically disjointed positions held by social actors' that are created in the city, which demonstrate our relationship to the wider surveyed and monitored landscape with which we complicitly interface that therefore becomes the main exploration in the artworks. The complicit nature of our behaviour in these systems is demonstrated in the multi-disciplinary expression of the artworks which is drawn out through the investigation of surveillance technology and has become the unique contribution of the artwor ks to the area of media arts in relation to the surveyed monitored space. These cutting edge artworks which have been realised through technological experimentation and exploration have been referenced and exhibited on the international stage in exhibitions connected to media arts, surveillance, smart city, and the Internet of Things (IoT), by numerous authors and curators[3].

The city, the industrial landscape and the sights and sounds of the urban landscape have been the subject of Stanza's work for forty years. The work is driven by a fascination with maps, urban planning, the architecture of concrete tower blocks and the growth globally of the world's cities.[4] In this thesis the city is explored and observed through surveillance systems (CCTV) and the new technologies of the Internet of Things (IoT) 'smart cities'. These are increasingly rolled out in all cities mainly because that is where all the people are. It is this incorporation of technological layers, the invasion of privacy, that then affects the social and the political or public sphere. Additionally the artworks contribute to a new understanding of the artistic landscape

[3] Curators for The Nemesis Machine (see section 6) include: Andrea Hawkins, Irini Papadimitriou, Emmanuel Cuisinier, Sarah Cook, Till-Holger Borchert, Ine Gevers, Ghislaine Boddington, Marco Mancuso, Piotr Krajewski, David Drake, Lucy Johnston, Christiane Paul, Richard Rinehart as well as numerous press reviews, catalogues, and radio interviews.

[4] Previous artistic outputs have been realised as paintings, LPs of music, videos, cd roms, and internet sites.

which has traditionally been interpreted through painting in art history but can also be expressed through these new technologies which offer a different and additional perspective of both time and space.

Stanza's practice involves creating these spatial manifestations of the liquid spaces across the city and in the landscape. The platforms and systems the author created have become not only relational but alive and given agency with real-time data, not just triggering lists of historical assets (data, texts, video etc) to give this illusion. The new media artworks surveyed in this thesis can be differentiated from the fixed asset and interactive systems being presented at the time by Rafael Lozano-Hemmer[5] and Jason Bruges[6] studio, with a contribution to knowledge expanding new media practice at that time (2004).

It is the practice of ‘mashed-up’ city-wide performative experiences, evolving in real-time, and represented as systems of control which are made available to audiences globally by being made and shared online through the internet. This process of engagement forges the practice into an original space, that of panoptic aesthetics in the field of media art. This is developed from the use of these systems of control to envelop the whole landscape, the city, the world as a panoptic space which becomes the canvas which is being remediated by the tools of new technology, by languages of software into the algorithmically dynamic self-generating artworks that are finally experienced. Furthermore it is argued that we are complicit and enangled in these technological systems where the we acknowledge we are surveyed and monitered. Not only are the artist's sensors placed in the city; the data is parsed over the internet through online platforms to facilitate this remediation. Therefore, all of these artworks in some form inhabit a real-time online networked space offering many other dimensions of experience and shared possibility.

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[5] Rafael Lozano-Hemmer used remediated pre-recorded data sets in a database format and not cameras in real-time for surveillance. For example Underscan appears to be real-time but it is an interactive system triggering pre-recorded videos as people move in public space. From (2004 - 2010) http://www.lozano-hemmer.com

[6] Jason Bruges Studio. https://www.jasonbruges.com

Throughout the investigation the author was speculating that artistic metaphors are needed to try to imagine the city at a different scale which is not bound by the scope of the gallery. The research framework devised methods that would extend our imagination and enable that perception of the city as a dynamic network of virtual data. Thus the extended research ambition of the project was to put technological systems in place in the city that can re-employ our perception and thus create a new understanding of how this behaviour unfolds and demonstrate that there are patterns, that they are connected, and the systems that evolve can be simulated and acted upon.

In this thesis a series of artworks are presented (see Sections 3 - 6): Sensity (2006 - 2009), House (2007), Gallery (2008), Data Data Data (2010), Singing Trees (2008), A World of New Possibilities (2010), Sonicity (2010), Body (2010), The Nemesis Machine (2010 - 2017).

They are all made using the collected data and this data is interpreted via the specific developed technologies to realise the artwork. There are many unimagined threads of data and connections that describe our world that can be explored through wireless mobile networks within which we can create artistic interpretations. The objective was to 'remediate' these collected data streams into cultural artefacts (artworks), making a contribution to the field of networked media arts practice. This at the same time discloses some of the problems encountered in trying to address specific research questions, including concerns with open data methods as well as the problematic technical issues encountered during the evolution and development of this body of artwork especially in relation to real-time feeds.

1.1 Context and Rationale

The published artworks have traced a shift in media art from modernist approaches of asset gathering (linear construction of media assets from 1980) to arrangements of datasets in fixed lists or databases (interactivity from 1994) to new methods of mining information across networks in real-time (generative and real-time systems from 2000).

This was achieved by culling and hacking data and information off the internet, taking images and feeds off cameras used in surveillance networks using CCTV (Urban Generation 2002), or for example making visualizations of cities from data using wireless sensor networks as in the cases explored in the list of publications which are deeply embedded in this inquiry (Sensity 2006 -2009, The Nemesis Machine 2010 - 2019 et al).

Following these shifts from video to interactive to generative in the author's practice an example (out of scope of the thesis) can be seen in the video artwork Conundrum (Stanza,1986), where the flow of assets only moves in one direction allowing for a fixed interpretation of the artwork. Interactive online artworks in this case facilitated by shockwave[7] technology allow assets to be recombined via the users' choice allowing an interactive engagement and thus variability in the experience. This can be seen for example in The Central City (1996)[8] and dozens of online projects by the author. Finally, the use of real time camera feeds or real time data allows platforms to be built that create a living generative recombination of the results as controlled via the algorithmic process. This can be seen in Urban Generation (2002), Sensity (2006) and all of the artworks described in detail that are included in this thesis.

Overall the outputs vary from visualizations communicated over the internet and represented as urban screens (Public Domain 2006), installations of data driven objects (Sensity 2006), software systems (Sonicity 2010), and mobile phone apps (Velocity 2017 - 2019). Embedded in each artwork is the acknowledgement that each informational space is networked by different complex systems, some visible and some invisible, and all using and representing data from city networks and informational spaces.

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[7] Adobe Shockwave (formerly Macromedia Shockwave) is a discontinued multimedia platform for building interactive multimedia applications and video games. Shockwave supports raster graphics, basic vector graphics, 3D graphics, audio, and an embedded scripting language called Lingo.

[8] Complete achieved project available on 1996.The Central City by Stanza www.thecentralcity.co.uk

The published artworks all disclose ways in which data connect between different technological environments, objects, systems, and users that describe our experience of the real-time city as space.

1.2 Research questions

Over ten years three identifiable questions evolved which underpin this thesis. The questions serve to foreground the research and methods for the purposes of key arguments and focus on the contribution to knowledge:-

1. What possibilities do real-time data resources representing city environments offer artists?

2. How might artworks enable us to reflect critically upon issues concerning surveillance?

3. What plastic, sculptural and visual forms might data-oriented digital artworks take?

The artworks (Sections 3 - 6) Sensity (2006 - 2009), House (2007), Gallery (2008), A World of New Possibilities (2010), Data Data Data (2010), Singing Trees (2008), Sonicity (2010), Body (2013), and The Nemesis Machine (2010 - 2017) were selected because they are connected via shared methods and development processes. The knowledge gained from each of the earlier works was then applied to various techniques to make this body of new media artworks from the Sensity project (Section 3) culminating in the last project titled The Nemesis Machine: From Metropolis, to Megapolis, to Ecumenopolis (Section 6).

2. Contextual Review

This section guides the reader through selected contextual arguments by reviewing a brief history of digital art concerning surveillance-based artworks and real-time data systems, networked space, smart cities implicitly connected to the artworks in the list of publications (2007 - 2017). The section is divided up into separate headings to help the reader through this complex interwoven interdisciplinary landscape.

Figure 1: The Nemesis Machine at IoT World Forum (Stanza, 2017)

In summary, the text traces the author's main theoretical interest that supports the publications. Because the artworks are time-based, the text will reference the themes of technology and particularly real-time systems art which are implicit in the practice.

Furthermore, this contextual review makes explicit key references to a wide range of theoretical sources that shaped the practice, from Bentham to Foucault to Deleuze, and then on to Lyon and Bauman: creating a thread on surveillance and visual cultures which was interwoven in the development of the published works.

The artworks use smart sensors IoT[9] and this can also not be separated from what is termed 'smart cities' and therefore this interwoven interdisciplinary thread is also addressed.

2.1 Artistic Practice. Aims, Objectives and Methodology and Practice

In general, there are three simplified methodologies that are common to all strands of the working research practice. These involve:

Collecting environmental data using wireless sensors.

Visualizing data through iterative experimentation to make these data represent something that supports the artistic contexts.

Displaying these data. Placing in an artistic context the ways the audience experience and come to a concurrent understanding of the outputs.

This modus operandi is typical for all of the artwork in *The Emergent City* series. As such, all the resulting artworks also adhere to the research objective to represent the real-time conditions of the city allowing critical reflection of the real-time city and creating a dialectic about the social and political undercurrents embedded by unfolding the real-time city through analysis of data and information.

The research is situated in relation to researching surveillance technologies and the monitored environment and, as the artistic concepts develop, the working models,

[9] Internet Of Things. (IoT). The term is used for millions of small connected computer devices.

platforms and artistic prototypes (discussed later) are created.

These works create new knowledge as art or more specifically new media art. The term ‘media art’ itself has become generic and broadly can be said to be any art using new technology; it can include digital art and internet art, for example. Artistic practice has changed and broadened so much in the last forty years that the overall context used for defining media art as a separate strand or genre has become more problematic and obscure. Areas bleed into one another, practice overlaps, and there is a rush to suggest that all creative work is art. 'No topic, no medium, no process, no intention, no professional protocols, and no aesthetic principles are exempt from the field of art' (Weintraub, 2010, p8).

The research methods include a myriad of technologies used in order to express various artistic paradigms which also affect the way we perceive, process and respond to visual information technologies. The interdisciplinary methods and novel outputs within this thesis reflect this current position where research methods underpinning digital art and media art are one and the same.

This observation is shared by Christiane Paul, who notes: 'Digital art has brought about work that collapses boundaries between disciplines - art, science, technology and design - that originates in various fields, including research development labs and academia' (Paul, 2002, p.22).

In his book '*Art Practice in a Digital Culture*', Charlie Gere states that digital arts are particularly well positioned to address the problem of new knowledge in visual arts, 'research is being institutionalised as a defining component of the academy of art; the academy has become a site for the production of knowledge' (Gere, 2010, p.12). The artworks and contribution to knowledge cited in this thesis are therefore characterized as being practice based; 'That is research carried out in practice and carried out through practice' (Gray, 1998, p.82).

This multi-disciplinary approach in the presented projects is something that has

seamlessly entered the author's artistic practice over thirty years. By understanding how to use technology in creative and novel ways, the author has engaged with and developed a whole range of technological tools. Therefore, the output (the artwork) also becomes a map of shifting technological realities and possibilities. The knowledge of specific technological systems (wireless sensors, CCTV, robotics, the internet) facilitates speculation on how we can merge collected data from various real-time situations, in particular, the author's interest in the city as a system (Mitchell, 1995). These investigations infer a new virtual space where the networked online city spaces could overlap[10] without borders creating possible new artworks. Hence the body of media artwork presented.

Applying this to practice one has to experiment and get under the bonnet of the technology to understand how it works and then create new outcomes and new experiments that will shed light on how data flows overlap in live streams, thus demonstrating what the possibilities are for novel artistic experiences and outputs. This open methodology led to the creation of sonifications, visualisations, and sculptural objects; as well as apps and feedback into other networks and integrated systems. Charlie Gere acknowledged how this works seamlessly with technology as part of the practice when writing about this work in the essay, '*Stanza's Object Oriented Aesthetics*'[11] (Gere, 2014).

The methodology was identified through the analysis of the completed research, and through the evaluations of research in progress and fully disclosed itself only at the end. The experimental and iterative methodology within *The Emergent City* served as a relativist position where realities exist in the form of multiple mental constructions. As such this approach corresponds to the definition outlined in the seminal work on practice based research (Malins and Gray, 2004).

'The (artwork) embodies a constructivist paradigm which is characterized by a 'relativist' ontology (multiple realities exist as personal and social constructions) and

[10] Stanza has referred to this overlapping augmented virtual area as The Third Space in his follow-on funding bid to the AHRC (2010). Referred to here online in his blog post. https://stanza.co.uk/emergentcity/?p=1267 [Accessed 6 Oct. 2019]

[11] Archived online https://stanza.co.uk/about/essays/GERE_StanzaV3.pdf [Accessed 6 Oct. 2019]

the epistemology is subjectivist (the researcher is involved); as a consequence, methodologies are hermeneutic (interpretative) and dialectic (discursive)' (Malins and Gray, 2004, p.20).

As the artist and the researcher practitioner the characteristic of this ‘artistic’ methodology is pluralistic, and incorporated by multi-method techniques, where each digital art project is customised to the individual artwork under discussion. This has involved the use of specified multiple media and multiple technologies to integrate the visual, tactile, experiential data into ‘rich’ information embedded in the visual digital artistic outputs connecting, data, the city, and surveillance.

Many of the artworks are framed by their interdisciplinarity and can acknowledge collaborative methods in the sense that the final outcomes rely on other technologies already developed or other software systems (operating systems[12]) and networks of data that are all brought into the narrative.

Donald Schön suggests that intuition and prior personal knowledge play an important role. Indeed while speculating on the research methods used, it was often at a gut level of response that drove these experiments forwards. 'Reflective researchers in situations of uncertainty, instability, uniqueness, and conflict, have recast the relationship between research and practice. Therefore research is an activity of practitioners' (Schön, 1983, p.308).

As a valid contribution, what all these artworks have in common is that they suggest a larger schism and vacuum in the way we understand how the ubiquitous embedded technologies of today are disempowering us, and through the surveyed gaze entrap us into believing that the technology is liberating. The artworks suggest alternative visions of reality that may hopefully have never existed.[13] However, since they are made in the now and experienced in real-time we actually find this world already exists, for example in the form of the Chinese surveillance state[14]. These concepts are aligned with the

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[12] One such operating system is Tiny OS the open source platform developed at University of California, Berkeley which is deployed on the sensor boards.

[13] Note, in light of Covid 19 tracking APPS it seems many of these speculations are indeed reality.

[14] China has turned the northwestern region of Xinjiang into a vast experiment in domestic surveillance. The country is perfecting

term surveillance capitalism, addressing the process of commodifying personal data with the core purpose of profit-making (Zuboff, 2019).

The artworks uniquely present both the audience and the data as a commodity which is performing in dialectic within the landscape in real-time because of the technology, thus demonstrating or coming to some reflective understanding of this landscape shift a decade before Zuboff's book. The artworks Sensity (2006 - 2009) and The Nemesis Machine (2010 - 2017) by operating as visual art machines act not only as art but also thematically as research experiments in the digital media art field in which they are sited. It is not so much creating a formal knowledge as ‘thinking in, and through’, within art (Borgdorff, 2013, p.143).

Parallel to researching sensor-based technology, the aesthetic development of any of the systems outputs plays an essential role. By investigating different ways to represent these data, it was possible to develop different ways to question the meaning of the system facilitated by building these art systems and platforms to experience the outcome. In other words, the practice also involved engineering new tools and creating custom made software platforms in order to create the artistic vision and address the research questions.

The research therefore also explores how digital media art and its distribution can keep pace with the rapidly changing technology which includes data from security tracking, traffic data, and data from environmental monitoring that has all been interpreted to make these artworks.

The interdisciplinary use of new technologies to make new kinds of art, effecting changes in products at their inception, also provides a showcase for technology and art generating new ideas concerning the ethical and socio-political issues surrounding data, tracking and surveillance.

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a vast network of digital espionage as a means of social control—with implications for democracies worldwide. Ref https://www.theatlantic.com/international/archive/2018/02/china-surveillance/552203/ [Accessed 2. June. 2018]

In summary, the development of this practice became focused towards a more interrogative approach to privacy and ownership of data within data flows using mobile phones in the city, and these artworks could be seen as addressing a broader concern, namely the securitization of space, experienced in House (2007) and in the more recent artwork The Global Dérive (2017).[15]

2.2 The Surveillance City to The Data-Driven City.

> 'Imagine walking out the door, and knowing every single action, movement, sound, micro movement, pulse, and thread of information is being tracked, monitored, stored, analyzed, interpreted and logged. The world we will live in seems to be a much bigger brother than the Orwellian vision; it is the mother of 'big brother' (Stanza, 2004).[16]

This statement cuts through all the artworks and art platforms made (2007- 2017) that repurpose and unfold layers of data. It is the rationale for all the artwork made by the author that manipulate and reform other content over networks to make art.

The field of surveillance studies, now firmly established in academia, was central to the research of the work and included Foucault, who made a link to Jeremy Bentham the English reformer who utilised the Panopticon[17] as a metaphor for contemporary life. Therefore permanent visibility assures the automatic function of power; this spurred a proliferation of texts and theory in the field. As Foucault puts it, 'The Panopticon is a marvellous machine which, whatever use one may wish to put it to, produces homogeneous effects of power' (Foucault, 1975, p.289).

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[15] The Global Dérive: A phone tracking app. The software is developed and deployed as a playful investigation into merging private data. The challenge in the artwork is to reclaim into the public domain personal information shared ownership and sense of belonging to the system removes a layer of control. http://thebinarygraffiticlub.com/derive.html [Accessed 12 June. 2019]

[16] Quoted from the author's essay published in Media Art and the Urban Environment: Engendering Public Engagement with Urban Ecology. Springer International Publishing (2015). Marchese, Francis T. (p.212)

[17] The panopticon is a type of institutional building and a system of control designed by Jeremy Bentham in the 18th century and brought to life in the form of a central observation tower placed within a circle of prison cells. From the tower, a guard can see every cell and inmate but the inmates can't see into the tower. Prisoners will never know whether or not they are being watched.

Gilles Deleuze writing in '*Postscript on the Societies of Control*' (1992) revised the model from the disciplinary society, moving on to the surveillance society. David Lyon then suggested that the '*music is made*' in collusion with the conductor reinforcing a centralised position of control but inferring a symbiosis (Lyon, 2006). The author's position in this thesis suggests we all have become complicit by our agency; we are active in our feedback, contributing and collaborating with the methods of surveillance. This relationship becomes more like an entangled mesh of interactive connectivity and exerts itself in hybrid liquid form now far removed from the original Bentham Panopticon; which is actually linear and fixed. The era of universal surveillance has been created and moved into the mainstream arena with the high profile cases of Julian Assange and Edward Snowden. We might not agree to this, we might rally against the invasion of privacy and constant monitoring, but it does not stop us using our phones, our computers and submitting our data.

To varying degrees, it can be observed that as the technologies have changed during this period many artists have immersed themselves in this broad trajectory and followed this rhetoric and to some degree have been influenced by or imported these theories into their art practice.

However, the symbiotic relationship of the artistic and technological practice explored here extends from discourse to practice, through the means of network-based devices, first lens-based (cameras) and then data based (sensors), from surveillance to dataveillance. While being consciously aware that although the landscape is being portrayed and represented, it is the context of deployment within the technology and the degree to which the content (image and data) is manipulated that give wider context and meaning to Foucault's (1975) '*machine*' for creating and sustaining power.

In the data-driven algorithmically driven artworks what is also made malleable are the wider systems of the networks of data from the city. For example, in an early work Urban Generation (Stanza, 2002) three hundred cameras are networked into the online artwork which is reworked by an algorithm in real-time. Control is leveraged from one

system of control and re-presented back to the audience as an open system within the aesthetic gaze. In this case the three hundred cameras from all over London are utilized in real-time as hundreds of images are refreshed to the screen as a manipulating kaleidoscope of constant observation. The agency of the data is alive and corruptible and made malleable demonstrating real-time performativity as well as possible networked disruption and abuse.

Essentially content derived for one purpose is now interpreted and the data, in this case image-based, is reformed to create a screen-based artwork. In this technological system it is the code, the algorithmic interpretation of the data that facilitatates the opening and closing of gateways to create new meaning. This narrative also creates borders, within databases of locked or private information. On a smaller scale all of these networks serve to illustrate similar intention and purpose. Essentially algorithms have been added to Foucault's list of prisons and once again these platforms serve to illustrate our complicit relationship to this interrelated world, trafficking meaning in varying directions. The algorithms build an invisible layer around our experiences online.

In the catalogue for the exhibition '*Please Come Back*'[18] (Lovink and de Vries, 2017) the observed panoptic layer is extended further. As sensors track your movements and aim to read your mind, the technology seeks to re-purpose God's role in the hierarchy. The panoptic all-seeing eye is focused on the '*prisoner*' within the walls, inside the database, via drones, maps, sensors, and cameras, all the while watching everything.

Speculative art practices have problematised the loss of privacy from different perspectives and this issue aligns itself with the substance of the artworks under investigation. David Lyon in conversation with Zygmunt Bauman proposed that it is in the city that we experience surveillance in ways that are multi-faceted, multi-layered, and moment by moment (Bauman, Lyon, 2012). Therefore it is the real-time moment, a

[18] Please Come Back (2017) was an exhibition in Rome that included The Nemesis Machine in the catalogue. The exhibition presented an overview of artworks that resonated with the topic surveillance and art. From an art historical perspective this was the most complete exhibition since Ctrl Space (2001) Rhetorics of Surveillance From Bentham to Big Brother.

constantly monitoring city via ubiquitous technologies that is the focus of the artwork, as it is in the ever present that we are always under observation. Within this context all the artworks in some way sort the city and its concurrent behaviours via the ubiquitous technologies of today (CCTV cameras, sensors, phones, databases, code, algorithms).

This section of the literature review positions the author's artworks in relation to surveillance ‘culture’. It argues that the artworks all align themselves within this discourse and demonstrate an understanding of the author's interest both in the city as a system, and the technologies used in the city for observing and monitoring space and people. This inherent feature of surveillance and control within digital communications now blurs the digitally panoptic and Orwell's big brother which have become one and the same. A seminal moment for the author in the ubiquity of surveillance in society was the infamous James Bulger[19] murder which was caught on closed circuit television systems (CCTV). Since 1993 this technology has increasingly embedded itself in the landscape and urban fabric.

It is therefore important to first investigate how surveillance culture has been adopted by the author, both in relation to other artists working in the same period and through the approach to what can be described as ‘lens based surveillance’, often using CCTV. The field however is now very broad as the social, political and individual invasion of privacy has been highlighted by scholars and academics, not just artists. Whilst the sheer breadth of this discourse largely falls outside the remit of this thesis, it is however worth acknowledging.[20]

2.3 Surveillance and lens based arts.

Surveillance art is here split into two areas, the lens-based video art that emerged from

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[19] The moment was caught on Closed circuit television (CCTV) at 15:42 as low-resolution video images of Bulger's abduction from the New Strand Shopping Centre in Bootle, Liverpool on Friday, 12 February 1993. Councils and police have argued that CCTV can be used to prevent crime; this initiated a huge investment in CCTV in the UK.

[20] For further reading see Theorizing Surveillance. The Panopticon and Beyond. Edited by David Lyon (2006)

about 1969, followed by a liquid networked data space, which is termed dataveillance, made visible in the author's artworks since 2004.

There have been many international exhibitions about surveillance in the last twenty years. Two examples are '*Ctrl Space*' (2001) at ZKM in Germany and '*Please Come Back*' (2017) at the MAXXI in Italy which included the author's work in a large catalogue. The latter addressed the world as a prison, and set out to remind us about the relationship between artistic creativity and surveillance and control.

The discourse that contextualises the digital artworks in these exhibitions concerns both environmental monitoring and surveillance that operates between both the lens-based and data-driven technological inquiry. As the research publications highlighted do not exist in isolation from previous research it is useful to initially provide some continuity of the author's practice, shining light into the social and political relationship of the new optics that are offered by surveillance culture and the technology as a framework for artistic expression.

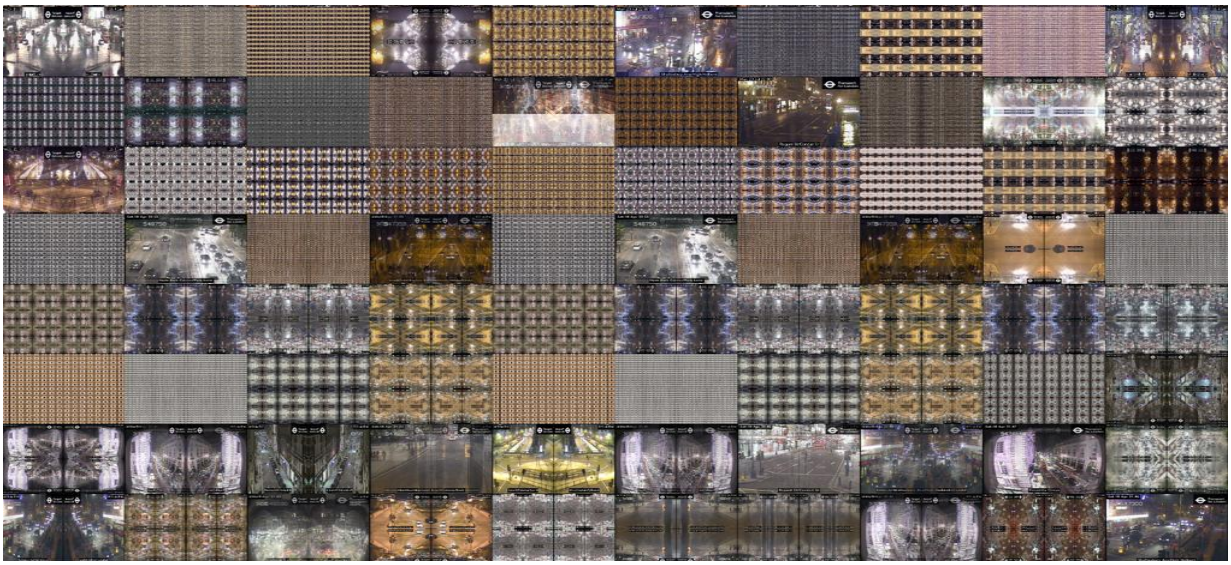
Artists that have made artworks using lens-based surveillance technologies include, Nam June Paik, Dan Graham, Julia Scher, Peter Weibel, Bruce Nauman and more recently James Coupe, Jill Magrid, David Rokeby, Manu Luksch and Rafael Lozano-Hemmer[21]. All of whom have incorporated reflective surfaces and lens based CCTV (surveillance) cameras that vie for attention via the spectacle of society. In what might be termed as a contemporary version of Lacan's *mirror gaze* 'context produced content and overarching sociopolitical systems regulate behaviour' (Albu, 2016, p.110). This acknowledges of Lacanian psychoanalytic theory, where the person subjected to the 'gaze' encounters a loss of autonomy upon awareness that he or she is a visible object. The gaze can be understood in psychological terms: 'to gaze implies more than to look at - it signifies a psychological relationship of power, in which the gazer is superior to the object of the gaze' (Schroeder, 1998).

[21] These artists and artworks are well known, for example:- Nam June Paik's TV Buddha (1974) is a closed circuit video installation, bronze sculpture. Dan Graham's Time Delay Room (1974) were two rooms under surveillance by two video cameras with an eight second delay. Julia Scher's Predictive Engineering (1993) is a multichannel video and sound installation, with live cameras, sensors, microphone, mirrors, tape, plastic balls, drone. Peter Weibel's Endless Sandwich, (1969) a closed circuit video feedback. Bruce Nauman's Video Surveillance Piece: Public Room, Private Room. (1969). More recently other artists using surveillance cameras include James Coupe's Sanctum (2015) CCTV tracking in the gallery with added narrative of storytelling. Jill Magrid's Evidence Locker (2004) where the artist collected videos from Liverpool CCTV networks with herself in the images. In David Rokeby's Sorting Daemon (2003) the system looks out onto the street, panning, tilting and zooming, looking for moving things that might be people. Manu Luksch created Faceless (2007) from CCTV footage blocking out the faces. Rafael Lozano-Hemmer's Zoom Pavilion (2015) tracked visitors in the gallery.

In this thesis the concern is broadened to investigate the city-wide surveyed reflective gaze. This is in order to encompass a larger surveyed space since it's mainly the city that is under constant observation, but also to focus on the ubiquity of the technologies under discussion. In order to make the artworks eternally current and facilitate one of the artistic mandates, real-time networked cameras are adopted and hacked to create large scale information networked artworks; thus making networks of networks, creating a real-time multiple-point perspective and moving the scope of the artworks outside that of the gallery or typical installation.

Several earlier artworks made between 2000 and 2005 researched systems for data usage that could access vast areas incorporating ideas about lens based surveillance, control, and the performative quality of real-time media. These needed to be investigated and brought into the discussion further, to illuminate the development of the ideas of surveillance and control within the artist's practice. 'Urban Generation; trying to imagine the world from everyone else's perspective, all at once'. (2002 - 2004) illustrates this.[22]

Figure 2: Urban Generation (Stanza, 2002 - 2004)



The data (images) pictured are re-mixed into this online artwork that looks like a filmic experience, but it is not a film. This 'filmic system' is constantly evolving and will never

[22] Urban Generation project archive http://stanza.co.uk/urban_tapestry/index.html

be the same again; the images are not recorded. Each screen is a live real-time image from one of hundreds of cameras in the city of London.[23] This generative artwork called into question the 'urban generation', a period during which the threat of terrorism has made our environment ripe for surveillance and privacy abuse. Private space has become public space, public space has evolved into covertly governed or overtly corporate space. The border of this space cannot be separated in this panoptic mirror gaze.

The artwork creates online a unique interpretation of a multi-point perspective of the city that exists always in the present time. The system expands both the distance and experience of the artwork not limited by other artworks presented as gallery installations, and this systems based artwork has moved beyond the linear and the interactive to fuse a hybrid interweaving generative system. The artwork is exploring the rhizomatic multi-nodal networked experience connected to the theme of networked panoptic surveillance that occurs in all work that follows, and this was an important breakthrough point in the practice. This artwork identified that the observation is a global system which led to the speculation of a larger technological sphere that could be interrogated via sensors.

The city can therefore be seen as a giant multi-user multi-data sphere. To take part you really have to put something back in; that's like life. To take part you have to input data so others 'may' see the output of the data response. Albeit in this case you don’t have a choice since this panoptic manifestation operates without our permission regardless.

Within the landscape and the city this mobility can be identified through traffic patterns, pedestrian patterns, in ways similar to seeing bird flocking patterns. Pattern recognition can be seen in the architecture, patterns in the buildings, patterns in the architectural fabric of the urban design network. And closer inside the micro patterns of the city, we

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[23] As Jo-Anne Green from Turbulence.org states:- While Stanza is well known for his interactive/participatory art, the “viewer” is forced to passively observe this piece, which simultaneously serves as a call to action. According to the Associated Press [http://www.msnbc.msn.com/id/8501576/; July 7, 2005] an estimated 4.2 million cameras largely concentrated in London and other major cities observe Britons as they go about their daily business, and it is widely estimated that the average Briton is caught on various cameras up to 300 times on a normal day. Net Reality Exhibition Catalogue (2005) UK.

have the life cycles of the atomised, the insects, the life of continuity, all of which exist along a timeline of past, present and future. All of this is now part of the surveyed landscape we inhabit and navigate. Although it is outside the framework of this PhD these patterns are now also being investigated via machine learning and artificial intelligence in new work as artist in residence at NTNU in Trondheim, Norway.

This notion connects the reader to the wider technological ubiquity and ethos of monitored space. This interconnection suggests a value for this information of control which will be a new currency as power changes (within networks). Therefore the author speculated that the central issue to be developed would be the privilege and access to these data sources. Taking some of these data and making something (*artistic*) was an endeavour to reclaim ownership of the data and place it back in the public domain.

This theme of control or monitored space within lens based surveillance cultures is pursued further in the author's artwork Visitors To A Gallery, Referential Self, Embedded.[24] The 2008 installation version made and developed using CCTV in situ in the gallery, makes visible those things not usually shown in galleries and reveals the nature of gallery-visiting itself .

Artists have of course used CCTV and surveillance cameras for art for some time, including the Surveillance Camera Players who performed with props and subtitles, especially for CCTV cameras around New York since 1996. What the author's artwork highlights in the case of the visitors to the gallery is a critical view of the current rhetoric about visitor participation in galleries for, here, the visitor is not necessarily participating in the work voluntarily. The artwork acts to reinforce the complicit and performative agency the audience now has with these technological systems.

It is worth noting that the body of digital media artworks discussed in the portfolio of published work is linked to the prior investigations in previous artworks, for example,

[24] Visitors To A Gallery was developed as part of a Clarks Bursary at the Watershed Media Centre in (2004), it was re-curated by Helen Sloan in (2008) and shown at Plymouth Arts Centre UK and then again in (2013) at De Markten Belgium as part of a wider exhibition on surveillance in the framework of the conference Computers, Privacy & Data Protection.
http://stanza.co.uk/cctv_web/index.html

The Central City (1996 - 2001).[25] This project in turn, was influenced by Paul Henry Chombart de Lauwe's map (1952) which depicts all the walks a young woman took over a year (a time-based informatic) as well as Guy Debord's *'The Naked City'* (1957). In these examples, the map is reconfigured to give it new meaning, as a poetic assemblage, which is a theme addressed from the context of a layered virtual real-time data city, except the map now has performative agency, i.e. it's not fixed in time and space. These artworks produced relate to the current data flows witnessed in the monitored environment. This is evidenced directly in the research systems that are used to gather information via sensors in the field and relates to the Sensity project (Section 3). These data are harnessed to visualize the urban environment and spatial representations as dynamic real-time experiences of the city space.

In the digital artworks (2001 - 2017) connected with surveillance, where lens-based situations (CCTV technologies) are used, the concern is to use multiple lenses from multiple perspectives and incorporate the whole as a real-time networked flow. Images are not recorded; the emphasis is on the monitoring of people and public space as something ever-present. The system created has no past and no future, just the real-time ever-present moment where the landscape is a hybridized audiovisual representation of the data space.[26] The artworks become audiovisual representations based on the sights and sounds of the city's pollution, noise, traffic data and the people in it, as this is once again evidenced throughout the practice (See Section 3). Adopting visual and poetic metaphors enables this multipoint perspective, rather than the linear thread seen in the net-art works of others at this time.

This creates a constant view of world cities changing and evolving around the clock, recombining these data, thus acknowledging our integrated relationship to the wider systems where, 'we will also become exceedingly trackable, naked, predictable manipulated and ...programmable' (Leonard, 2016, p.37). The artwork seeks to place

[25] The Central City is an interactive online experience of abstracted cities. Here the city became an organic network of grids and diagrams, juxtaposing urban sights and sounds. This net art work exhibited in over seventy international venues is online and archived. www.thecentralcity.co.uk

[26] From 'My Net Art Condition' reflections on the obsolescence of technology in this case 'shockwave' text taken from Stanza'sonline blog https://stanza.co.uk/emergentcity/?p=2865 [Accessed 5. March. 2020]

the viewers and the experience of the artwork in the middle of this confrontation of the manipulated body (as an asset) in the data space (city).

Other artists who have used networked cameras in their artworks include Wolfgang Staehle who famously used the webcam pointing at the World Trade Centre when the planes crashed (2001). Thomson and Craighead (2004) also used found footage from the web to create short films. In both cases, the feeds were served up directly as they were found and create a more playful Duchampian vision of a found source recontextualised around another narrative.

What is different in artworks like Urban Generation (2002) was the re-appropriation of multiple feeds and channels, all operating at the same time, while representing them all back online through a browser to the audience, thus alluding to the network's space we have now become incorporated within. The audience was in the middle of a mega-structural form, the stacked city layer, monitored, and incorporated into a closed loop of consumption. Urban Generation is an interwoven tapestry of data witnessed by all in the online network which observes all in a real-time multi image surveyed event. This widening horizon of ubiquitous and enmeshed technology has recently been poetically described by Benjamin Bratton who questions what planetary-scale computation has done to our geopolitical realities; these computational layers, smart grids, mobile apps, smart cities have become inside of us while all now part of *'The Stack'.* (Bratton, 2015)

The multidisciplinary practice is designed to float and drift as data, and continually unfold through networks. The work is no longer determined solely by its existence on the web and operates within the field of 'expanded internet art',[27] as it demostrates various methods, both online and offline (Moss, 2019). This hybrid meshing of data, information, sensors, cameras and connectivity illustrate this expanded entanglement.

The artworks identified here also use these multiple sources and then go further to manipulate the aesthetic of the real-time feed. In other words, the system of control is

[27] Ceri Moss's PhD dissertation asks how the widespread technological capture of information found under an informational milieu affects cultural production, specifically contemporary art.

controlled by the artist's custom algorithm, albeit for aesthetic reasons, almost suggesting and demonstrating a reversal of trust in technological systems. The separate layer of intelligence (the algorithm) exerts a dystopian anxiety as we speculate how this massively distributed megastructure was re-fabricated on a planetary scale.

What differentiates these works is the context. These artworks exist to break down the networked image and redistribute it almost as a commodity, identifying the system of control that is increasingly becoming embedded everywhere. By using custom code however, the work manipulates the camera feeds to demonstrate that anyone can take control of the content and therefore the context. There is a newly emerging perspective shift created by presenting multiple different camera feeds to the screens at the same time. This multi-point perspective signifies a different experience and visual truth from the linear films of other artists working in this period. The sheer scale alludes to a planetary scale conglomeration that Constantinos Doxiadis (1967) referred to as Ecumenopolis[28], except now it has manifested as a virtual over-layer of systems technology which is planet wide and deeply embedded with dystopian panoptic overtones of an Orwellian sensibility.

It can be stated therefore that there is no centre in the data space; there is just this nodal mesh network that the individual is situated within. There is a reorientation to expanded internet art and what is termed ‘informational milieu’ (Terranova, 2004), a conglomerate of communication channels. The user and the audience are part of everything in this drifting space; shared overlapping.

The author's artworks of this time produce a different result at every viewing and therefore, a different experience of the artworks which can only be appreciated viewed side by side. If you sit next to someone looking at the same work on your machine, the screens are different. Thus, time and space are expanded into this artwork (see later).

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[28] Doxiadis, C. (1967). Ecumenopolis is the hypothetical concept of a planet-wide city imagined by Constantinos Doxiadis. Used by the author to contextualise a global surveillance system.

Here the aim was not only to play with the more familiar panoptic aesthetic presented by The Surveillance Camera Players,[29] i.e. perform against a backdrop or to something else. Yes we know we are being watched but the aim was to embed the total external landscape of everything inside the system which the audience then responds to and is being manipulated by.

This panoptic ‘gaze’, though slight, becomes a stepping stone both back to the past of Bentham and centralised control, and then to the future of data liquidity (Lyon, 2006) where there is no obligation; you do not have to take part as this system will run and continue without you, the audience. In the lens-based gaze of the Visitors To A Gallery (Stanza, 2008), you the audience become the art while it also claims you like data for consumption within the art experience. The artwork reduces the audience to be no more than an observable controllable asset or bit in the data sphere that is the gallery. Rather than witness the artwork the visitors are witnessed and mediated by the artwork. 'Visitors To a Gallery’ therefore becomes enslaved by the surveillance gaze creating cultural value and commodity. You do not have to play to the system as the system is now ubiquitous and full of data. The real-time relational data space, the sense city of layered information (surveillance lens-based) changes lane to the extended data-based, data-driven algorithmically monitored everything. In these artworks you have to be there to take part, by default. The body is needed in the data space; it cannot exist on its own. The panoptic gaze sells the obligation to cooperate, to play along; it is now a condition of the social.

Beryl Graham draws attention to similar motives in her essay on the author's work and provide helpful insights into this proposed allusory mechanism of control of the participatory and complicit interactive audience member.

'The audiences here are making their own damn art and have the freedom to make the content of the work itself, but because the CCTV cameras are capturing their image when they might not have been aware of it, they of course are not fully in control.'

[29] The Surveillance Camera Players (SCP) is a New York-based group founded in 1996 by Bill Brown which underlines the omnipresence of surveillance cameras, private or public, in cities.

(Graham, 2014).

2.4 From the Big Brother to Liquid Surveillance within the practice. From the camera lens (image) to the sensor (data)

Underpinning and embedded in both the early artworks and the key investigations into dataveillance[30] are a whole series of potential problems about observation, surveillance, and the ethics of the control space (controlled by machines). By researching surveillance systems, tracking software, sensors networks as a practitioner at any given time, the artistic outputs created demonstrate a concurrent understanding about the social and ethical implications of such technologies, both in artworks as well as public domain space. Indeed, the internet itself can be seen within the same panoptic sphere.

As Natalie Bookchin writes, 'the Internet ...can be used to make the world less free through control and surveillance mechanisms' (Bookchin, 2006, p.73).

The artworks deliberately speculate and allude to where these technologies could lead us in the future, especially The Nemesis Machine, the large cybernetic sculpture of city data (Section 6). While building art systems and tools to enable these systems online, further questions become highlighted about the ethics of the control space and surveillance space.[31] How we understand and value information is of great importance.

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[30] Data monitoring across networks to gather information creating new information channels of large environments and used in this context to explore data surveillance rather than lens based surveillance.

[31] See Robotica Control inside the Panopticon which premiered and The Victoria And Albert Museum, London (2008) and Gallery,

It seems reasonable to suggest that visual metaphors might simplify our understanding of data in space. By adopting visual and poetic metaphors for gathered data, this enables a perspective which Masayuki Fujihata calls a *'parallel reality'*.[32] He achieved this by using multiple participants walking with field devices and recording the outdoor spaces and can be compared to a film of an event, a history. It is clear in the work that the author has achieved something akin to the film event; however the multi-point generative system played out in real-time shows multiple possible realities, all in parallel and completely entangled.

In Public Domain[33] concepts of control and technological ownership in surveillance are investigated by giving away CCTV cameras and letting the public set up their own network of surveillance which was then made public, becoming a self observing transparent system.

Mixing both lens based surveillance and a dataveillance based system the artwork The Agency At The End of Civilisation (Stanza, 2014) also incorporated additional future predictive control and intelligence via a software system. The control system in this work is manipulated to redirect attention where the system wants. We live in an ever-changing real-time environment in which new technologies can capture data for a variety of purposes from surveillance to environmental monitoring. In this case the database is, in effect, manipulated to disclose another truth which alludes to new knowledge.[34]

In summary the lens based media artworks facilitate a novel understanding of the monitored urban environment and the research questions relating to surveillance. This

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Invisible Agency and Cultural Behaviours, made in (2008) at Plymouth Arts Centre.

[32] In conversation with Masayuki Fujihata on stage at his event in Tokyo in 2004.

[33] Public Domain (2005). Public Domain is a public artwork using surveillance technologies which have been given away by Stanza to members of the public. The project creates a tension around issues of privacy and ownership of information by placing the real time surveillance feeds online and sharing them with everybody as an open spectacle. http://stanza.co.uk/publicdomain/index.html

[34] This art installation presents data and information as a network of spatialized audio with spoken texts and generative visuals. The audience engages with the artwork as observers (of the surveilled and recorded space) looking at twenty four computer screens, a dozen speakers, and a labyrinth of surveillance cameras built as an art installation and presented on a plinth. The artwork makes use of a custom future predictive software while at the same time exploring time from multiple perspectives, a 'parallel reality', a reference to the work's ability to create multi-point perspectives in real-time. Custom made software interrogates the information flow in real-time and repurposes it to tell us a new and different story. The installation was commissioned and curated by Helen Sloan of Scan and exhibited at Winchester Science Centre UK 2014. New Media Gallery, Anvil Centre Canada 2016. http://stanza.co.uk/agency/index.html

is contextually similar to the series of works presented under *The Emergent City* from 2007 to 2017, but is now addressed via its data monitored platform.

The shift of this inquiry is now expressed through the use of a different technology, the panoptic gaze of wireless mesh sensor networks that are used to monitor and gather data from large scale urban environments and suggest an omniscient perspective of conservation.

During 2004, a substantial shift in the author's practice away from lens-based investigations of surveillance began that is central to this thesis and inquiry. It was the total city space as a source, the idea that every asset could be used to harvest the data to create a flowing liquid informational stream that is based on capturing and monitoring that could be described by the term data-veillance, the mix between data acquisition and surveillance that led to these works in this thesis. This transformation led to the realisation that the data spaces could interweave the body, global systems of information, and senses of everything in single artworks. In fact any data that can be harvested into technological interfaces were ‘valuable’ in creating both a new understanding of the world and therefore a new data stream, which could be financial, or climate based, but was in this case city wide monitoring in real time using sensor devices.

Therefore these intertwined environmental data layers and feeds embed further layers of mixed information and raise an important question about ethical accountability as to the right to the city and the consumption of this data as a material asset. In other words the suggestion is that these data and most types of data (logistics, people, tracking, quantitative behavior analysis) have turned themselves into financial commodity instruments to be bought and sold. Bruce Schneier (2017) puts it bluntly: 'Surveillance is the business model of the Internet'.[35]

This emphasis on the liquidity of the invisible world of flowing data is exemplified in this

[35] Accessed from this site on 4.6.2019 www.schneier.com/news/archives/2014/04/surveillance_is_the.html

observation from Douglas Rushkoff in The Guardian in 2019. 'What happened to us in the 2010's wasn't just that we were being surveilled, but that all that data was being used to customize everything we saw and did online. We were being shaped into who the data said we were. The net you see and the one I see are different.'[36] This describes an effect interrogated in the artwork Urban Generation (Stanza, 2002 - 2004) and The World Is Watching (2002), and later infused into The Nemesis Machine (Stanza, 2010 – 2017).

These artworks, by using data and referring to the control space, create new panoptic aesthetic experiences within this technological framework where we are actively engaged with surveillance not only through social media and through government agencies but also by our very agency in the system itself.

The body in the data space cannot be separated from it; it is an entity of the monitored that cannot be separated from the whole that moves under the umbrella term surveillance culture and as such is closer to some interlocking multi layered and morphing virus.

This model where a technical platform is developed to collect data facilitates remediation which then allows for any display or output within any new context. These operations when used as a methodology remain the core of the practice in all the artwork by the author.

In summary this work involves collecting data, remediating data and the display in some artistic form. Since this is no longer linear or restricted by the fixed asset database but operates in real time, then aspects of this temporality can also be located in relation to our usage activity and agency in contemporary globally embedded systems. This is a quality of data that refers to the carrying of mobile phones, being tracked via RFID, picking up tickets, being caught on CCTV and facial recognition, money transfer, spending habits etc.

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[36] Technology has grown from devices and platforms we use to an entire environment in which we function https://www.theguardian.com/commentisfree/2019/dec/29/decade-technology-privacy-tech-backlash

2.5 Real Time Systems

The artworks discussed so far all have connections with modes of performativity and developing agency across networks in relation to the technologies of the 'Internet of Things' (IoT). The data conversations take place in literal black boxes[37], inside the computers and networks whose operations are mostly hidden from us. The point of this work is to understand that everything now does indeed communicate with everything else, interlocking, interweaving, creating new perspectives. These new media artworks can be understood as an artistic response to our current mediated condition and to the new ontologies and philosophies it has engendered (Gere, 2014).

Maria Chatzichristodoulou likens these artworks to systems theory in her essay, *In Search of a Digital Masterpiece.*

> 'The artistic outcome of Stanza's work is an 'unobject' that becomes manifest as a complex system, interconnected to and dependent upon other complex systems, both organic (human bodies, nature) and inorganic (human-made

[37] Referred to here, a black box is a device, system or object which can be viewed in terms of its inputs and outputs without any knowledge of its internal workings and was adopted in systems theory as a model to test various inputs and outputs.

> structures). What is essential here is the turn towards the performative due to the liveness of the installations, which all depend on 'real' (i.e. collected from the environment rather than randomly generated) and real-time data. Stanza's current practice does not simulate the city, nor does it represent the city: it is the city. Even more poignantly, it is the city not as it has been, but as it is right now.' (Chatzichristodoulou, 2010)

This observation in which the real-time is ever-present and performativity is implicit in the work demonstrates its novelty. The idea is that the artwork as an avatar, a mirror, or another object sitting alongside the city, performing as the city, cannot again be separated from what we understand the work to be about. As a conceptual gesture, the work collapses the representational space of art rather than simulating or representing a closed structure (object or closed system); these works accurately perform their social milieu as a continually changing, alive, complex and dynamic open system.

What performance suggests as a worldview is that reality is not pre-given (and thus cannot be represented). What in the past would be a representation of the world around us (fixed in time) is replaced by an enactment of the world in the here and now. The world is actively performed anew. This is precisely what is achieved with this current artistic practice: to perform the world anew; to approach the world as a reality that emerges over time and is continually transformed through our history of interactions with it.

The dimension of the present moment or ever-present real-time is therefore enacted within Sensity (Stanza, 2006 - 2009) and The Nemesis Machine (Stanza 2010 - 2017). All the works refresh the systems perspective, always alive, seemingly performing itself as a virtualised machine interface, an expression of the now. As Paul Virilio stated when the art happens, in two or more places it is, '....being telepresent, here and elsewhere, at the same time, in so called real-time' (Virilio, 1997).

Here the term real-time refers to encounters in both the lens-based and data-driven artworks by the author using networked sensors and multi-media all concerning real-

time computing, which involves the processing of information and data, and this cannot be separated from all of the published works. The process of technicisation and digitalisation has increased reflection on time and speed and transformation brought about by real-time technologies (Bernard, 1994). This is encountered in the work by moving away from the fixed asset databases and utilising real time information flows via wireless sensor devices.

These artworks seek to unveil what is already there, putting together an assemblage of data forms and technical disciplines to produce a 'new kind of event' (Derrida, 1989). By doing so, they invent a new space, an overlapping virtual data-space, i.e. the mixed virtual real-time layer exploited by the author in all the research outcomes. Art becomes possible through these technically enabled real-time systems, 'the impossibility of technologically processing data in real-time is the possibility of art' (Siegert, 1999, p.12).

As systems based artworks they tend to shift emphasis away from objects per se and to make visible the invisible mechanisms of institutions and the proliferation of real-time systems by increasingly abstracting the concrete materiality of things into information. This is reflected as dataflows and as systems observing systems, which is what the artworks are. Similarly, Keller Easterling talks about infrastructural aesthetics, a mixing up of things to see the ways in which landscape is an information system, and cities are an information system. She uses the term disposition to locate activity, not in movement, but in relationship or relative position. This disposition uncovers through this technology enabling a hybrid reality transformation. It is only through the technologies that these alternate realities are brought into focus to be witnessed (Easterling, 2014).

'There are no spectators; everyone is involved in one way or another in the performance' (McHale, 1969, p.98). However it is through these (technological) devices that we can telescope time, move through history, and span the world in a variety of unprecedented ways.

If everyone is involved as McHale suggests, then in the final analysis the body cannot be removed from the technological monitored data space. Art will be created through communicative 'gestures in multi-media forms' in a society where there is 'individual initiative and direct participation in the control of complex processes' (Ibid,1969).

The dispositional relationship to interactive media is realigned from an interactive territory to a monitored and responsive space which is now global. This notion is implicit in all the artworks through to The Nemesis Machine (2010 - 2017).

The artworks all have in common these connections of relative networked data from across distance and are formed via an algorithmic interpretation or artistic intervention; evident in the form of singing trees, The Singing Trees of Tremouth (2013) to the kinetic Body (2012) to the cybernetic city The Nemesis Machine (2010 - 2017) et al.

Sensity, Body, The Nemesis Machine are all systems that utilise distributed space (the city) with deployed technical devices (sensors) to gather data in real-time. They all operate as 'real-time systems' which is the title of Jack Burnham's essay published in *Great Salt Works*. Burnham claims we have moved from object-oriented art to systems orientated culture. Moreover, he stresses that this emanates not from the things but from the way things are done (Burnham, 1973, p.16). The process of making alters the outcome of a system; it could be computation, it could be information design, but in the author's case, it is also framed as art.

Burnham in the early seventies saw systems aesthetics as a way to understand a layered connected art practice, something that Benjamin Bratton would refer to more recently as a stack, that is: interwoven, interlinking, meshed, embedded, not framed and constantly moving. There are no boundaries of operation; it becomes a complex of components in interaction (Bratton, 2015). They are therefore never independent but connected, responsive and interactive.

These systems (the city) might be altered in time and space and embedded with monitoring devices (the sensors). Therefore the 'system aesthetic' also becomes a

panoptic aesthetic. Systems are monitoring systems controlled by ever more sophisticated algorithms. The machine is intelligently controlling its own version of itself, performing in real-time (the avatar city) enabled through 'the means of research and production' (ibid, p.17). The author's artworks are not closed off systems but open to continual feedback, change, and response.

To quote from Burnham's lecture ‘The Aesthetics of Intelligent Systems' (1969):

> '*..the art of the future...with the ever steady evolution of information processing techniques in our society, an increasing amount of thought will be given over to the aesthetic relationship between ourselves and our computer environment*' (p.95).

The next section investigates real-time data artworks and the practice of others in the field relative to surveyed, monitored, technical urban space. Embedded deeper in this research are investigations into the patterns we make, which are all being networked into retrievable data structures that in turn are all being sourced for information and therefore used to create art.

2.6 Data and the surveilled information age related to new media art

The aesthetic development of the systems highlighted in the artworks and outputs are mostly created by investigating different ways to represent the data via wireless sensors and different ways to question the meaning of the system, evidenced in detail later. However, it must be stated in advance of reading about this work that this observation of real-time flow separates these artworks from others that might appear to be similar during this period.

A number of artists have concerned themselves with this larger surveillance gaze relating to lens based media (as previously mentioned). More recently the range of work in this field has expanded and it's worth listing some of these artists to give a broader based context to the field. Names include Trevor Paglen, James Bridle, who

often present the world that surveys us via other forms of evidence often photographic or textual. Hansen Elahi who surveys himself, creating a quantitative tapestry of self-observation such as in the artwork Thousand Little Brothers (2014), essentially a collage of his photographic self monitoring. Also embracing surveillance are artists Julian Oliver and Danja Vasiliev intercepting GSM[38] via WiFi (2014) to show surveillance agency traffic and its presence in the wider networks. In Sanctum (2015) James Coupe and Juan Pampin merge real time surveillance feeds into social media with facial tracking. These two artworks align themselves with a particular focus or narrative that plays over the systems to add context. Kyle McDonald presents Exhausting a Crowd (2015) which looks like a real-time event but is in effect pre-recorded and served up with a clock stamp which is in real-time.[39] Amy Alexander created Sven a computer vision system to identity rock stars via surveillance cameras. There is also the work of Neal White, Steve Mann, and others on ‘sous-veillance' which more specifically addresses recording of an activity by a participant in an activity, typically by way of small wearable or portable personal technologies.

The author's sensor-based artworks deal with the real in terms of the manifest flows of the data space or 'liquid' space that suggest a bigger system of control (Lyon, 2006). The world we live in seems to be a much bigger brother than first realised. It is now a world full of data that can help us understand the fundamentals of the outside environment as well as monitor the micro codes of our DNA. Security has morphed into a future oriented predictive mode witnessed in the film Minority Report (2002). The artwork Agency At The End Of Civilization (Stanza, 2014) speculates on such a future, where the entire situation is already enslaved by the data driven system, by incorporating millions of traffic data sets in real-time with hundreds of CCTV cameras and creating a database of fictional stories mixed into the final narrative. Surveillance here works at a distance in both time and space interlocking variable systems and recontextualises the result.

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[38] Global System for Mobile Communications.

[39] At the HTTP gallery in London in the artwork You Are My Subjects (2005) Stanza created a real time crowd via this internet artwork. Made utilising the camera outside a restaurant In New York City. The artwork ran in real time for the next six years on his website capturing anyone on range on the cameras into the artwork which could be seen by a global audience. (see archive https://www.stanza.co.uk/i_spy/index.htm)

From an artistic perspective the author's work does not exist in isolation from inquiry into data, surveillance or experiments with monitoring and communication technologies that relate to art. A number of artists have created work during the period of this inquiry that also operate in this field.

In context when typing the keywords data, art, and the city into Google to see how this artwork is situated in the field, over ten of the author's own projects appear in this image search. The search also brings back results relating to smart cities, data analysis and informatics and links to images representing beautiful data or information design.

In relation to the author's artwork and inquiry there are several projects with implied overlapping themes and technologies. This includes locative computing i.e. GPS and position sensitive technologies which lend themselves well to visual mapping and data representation, and various creative uses by others in the field parallel the author's interest in the monitored real time data city. This quick summary is included to give some broader insights as to the rather diverse field and are cited to demonstrate depth to the overall artistic inquiry within the field.

Mobile Bristol[40] created a toolkit which provided a digital canvas over the physical landscape onto which digital experiences can be painted. This kit for mobiles enables playful mapping and integration of various narratives over the city. Another influential project in this field is Christian Nold's Biomapping project (2004),[41] which created tools for visualising people's reactions and emotional responses to the city and allowed people to selectively share and interpret their own bio data. Urban Tapestries by Proboscis followed a similar vein of information mapping (2004).[42]

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[40] No longer online but is referenced at ths website https://www.watershed.co.uk/projects/mobile-bristol

[41] Archived on Christian Nold's website.http://www.biomapping.net/ (2004) Accessed.15.5.2019

[42] Investigated how the combination of geographic information systems (GIS) and mobile technologies (including ad-hoc WiFi) could enable people to map and share their knowledge and experience, stories and information via public authoring. http://proboscis.org.uk/projects/2000-2005/urban-tapestries/ Urban Tapestries (2002 - 04)

Figure 3: Christian Nold's Biomapping project (2004)

Beatriz Da Costa's Pigeon Blog (2006)[43] deployed homing pigeons armed with miniature air pollution sensors, GPS units, and transmitters connected to a web-server. The avian investigators evaluated and mapped local air quality, blogging that data in real-time on the project's social media website. The homing pigeons serve as live 'reporters' that investigate and make visible the invisible presence of current air pollution levels. PigeonBlog provides an alternative way to participate in environmental air pollution data gathering.

[43] PigeonBlog by Beatriz Da Costa. No longer online. http://www.pigeonblog.mapyourcity.net

Figure 4: Beatriz Da Costa's Pigeon Blog (2006)

Similar to the author's objectives which included a building management system of sensors was the Arch-OS[44] project created as an 'Operating System' for contemporary architectures and developed to manifest the dynamic life of a building as part of I-Dat, The University of Plymouth led by Professor Mike Phillips.

Several other Universities have now fully developed labs with investigations in this area of data infomatics. The MIT SENSEable City lab created The Mobile Landscape (2005), a data visualisation of cell phone activity in the city of Graz, Austria. This infomatic video rendered representation was created as a means of observing the city. It shows the city via a series of human interactions demonstrating the possibilities of the active participants.[45]

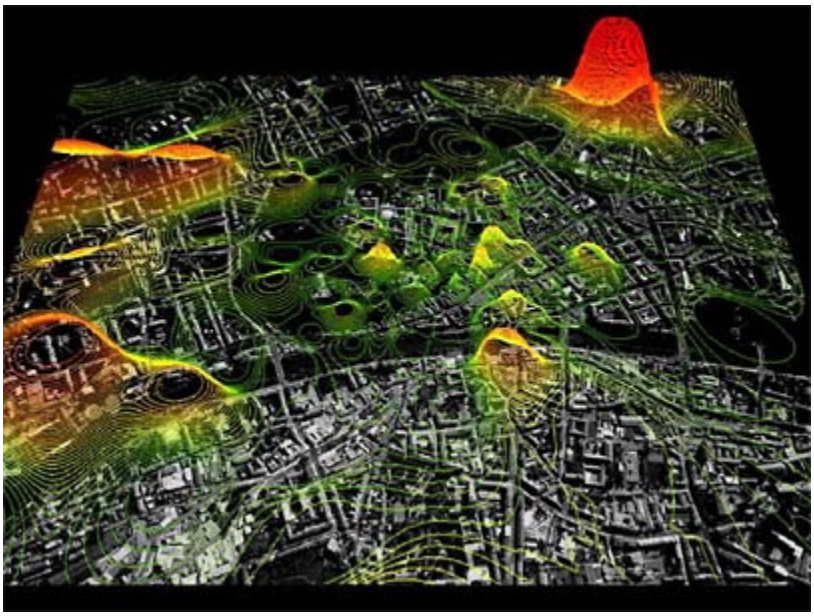


Figure 5: SENSEable City. The Mobile Landscape Graz, Austria (2005)

Another platform (datacanvas.org 2015) uses a sensor network to measure light,

[44] Arch-OS BEMS tool measures the environmental changes within a building. It is essentially a large database of energy usage and environmental control. See http://arch-os.com/system/

[45] The tracking and monitoring of users' phones could offer new opportunities for participation not explored by MIT. This is something the author would explore in 2017 in his project The Global Derive. http://thebinarygraffiticlub.com/derive.html

temperature, sounds, to create an interactive map.[46] One project within the platform called Sonic Particles is a real-time sonification of the urban environment. However it just presents a linear audio recording. The author created Sonicity (2010) that also sonified the urban environment and represented the result on maps and on 170 speakers but presents the whole result as a generative real-time audio feed which can also be controlled by the audience.

Furthermore, the cultural sector is also experiencing this developing impact demonstrated in current programmes by Future Everything's[47] IoT (Jan 2017) and the Collusion[48] data arts initiative (Jan 2017). Both organisations are currently working with artists' engagement with dataveillance, played out across the city of connected devices in Manchester and Cambridge.

Figure 6: The Human Sensor by Kasia Molga (2016)

Future Everything were commissioning artists within the context of the internet of things (IoT). The Human Sensor by Kasia Molga (2016) examined breathing as an interface to the city. However, whilst all these projects help to position the work in a period of interest in issues such as data visualisation (design and information), and the

[46] There seems to be no such platform developed. The data canvas actually shows no live sensor data but only the intent of creating real-time data and making art is similar.

[47] Future Everything https://futureeverything.org Working in collaboration with Cityverve, a citywide IoT platform developed by Cisco Systems. Stanza exhibited with Cisco systems in 2014 at the launch of their new smart city API.

[48] Collusion Cambridge. http://www.collusion.org.uk/about They commissioned artists for art projects related to the Internet Of Things.

internet of things (connected devices), they deviate from the direction of the thesis and the relational shift to the city system as surveyed monitored space.

By 2015 numerous artists are creating data visualisation as art. In fact the field has exploded with the idea that data can feed aesthetic coded systems to make art. In one example Refik Anadol used parametric data from the city and combined it with twitter to create a media wall at the 350 Mission building in San Francisco.

In Listen Tree (2014) Joseph Paradiso's students populated the marsh with sensors to record temperature, humidity, light, wind, sounds. Here researchers have hidden wireless sensor nodes, microphones, and cameras among the cattails and cedars in a Plymouth, Massachusetts, nature reserve. It is interesting to note that this technology, now ubiquitous in media art, occurs seven years after the author's own complex custom designed projects Sensity and The Singing Trees were realised using bespoke systems.[49]

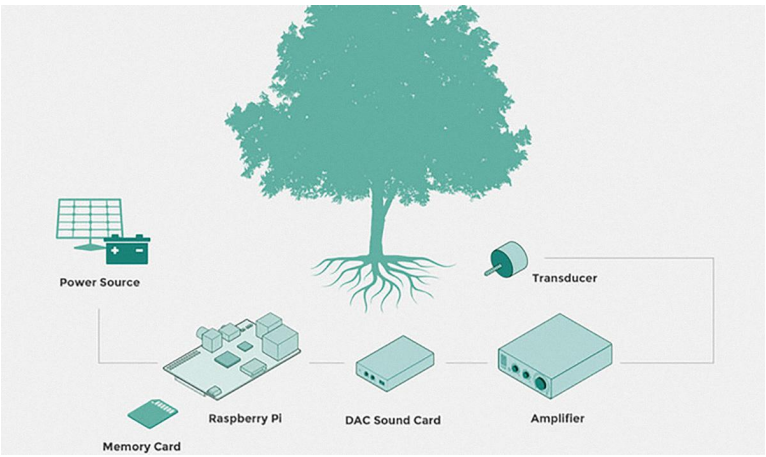


Figure 7: Listen Tree. Edwina Porto Carrero and Gershon Dublon at MIT (2014)

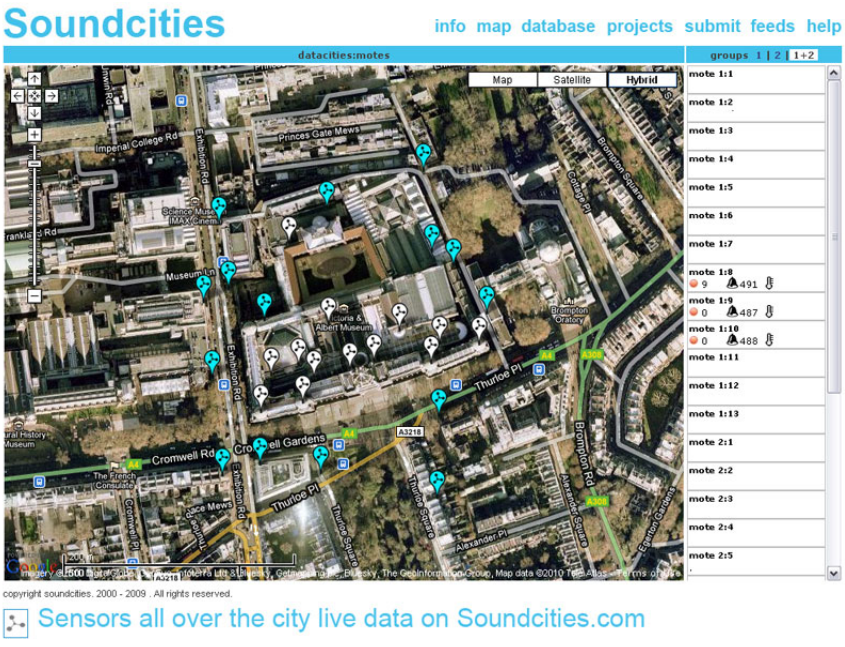
Paradiso also created DoppelLab (2015), a system that encompasses a set of tools for parsing, data-basing, visualizing, and sonifying these data, by organizing data by the

[49] The Singing Trees (2008) by Stanza make music and sing a song about the environment. The sounds you hear are the sounds of the changing environment Made using dozens of wireless sensors which are presented through a custom made speaker system for the audience to listen to and powered via solar panels. This is a responsive installation in public space, a sonification of the real space and the environmental data. http://www.stanza.co.uk/tree/index.html

space from which they originate.[50] This research objective appears to have explicit similarities to Sensity, Sonicity, and many aspects of the other twenty artworks that are the outputs from the author's research process.

However, Paradiso seems unaware of the complicit relationship to surveillance and monitoring and the complicit relationship of ownership and control inside these systems. Interestingly, this is also noted by Zuboff, who writes 'Paradiso does not reckon with the translation of his paradise of omniscience into the realpolitik of surveillance capitalism' (Zuboff, 2019, p.208).

In 2007, the author addressed this issue in the Sensity project evidenced in the project website. It states, 'Will the securitization of city space create digital borders that monitor our movement and charge us for our own micro movements inside the system?.....Or will it (technology) dominate and control us?' It can be argued that this awareness of this 'realpolitik' addressed these complicated relationships of ownership, and control, inside these distributed wireless networked systems (the artworks).



[50] DoppelLab (2015) provides a platform to make both broad and specific queries about the activities, systems, and relationships in a complex, sensor-rich environment. https://www.media.mit.edu/projects/doppellab-experiencing-multimodal-sensor-data/overview/ This was simalar to Sensity (2007) by the author who it suggested likewise that other artists can play with and mix the data. https://stanza.co.uk/sensity/index.html

Figure 8: Sensity sensors at the V&A Museum, London (Stanza, 2007)

Figure 9: Diller Scofidio + Renfro EXIT at the Palais de Tokyo, Paris. (2008 - 2015)

We can also see that at the time of writing, this field has expanded rapidly and curators have started to facilitate large scale themed exhibitions internationally. The Big Bang Data exhibition that opened at Somerset House, London (2016) and OJO al Data: Data Culture, Economy and Politics at Medialab Prado, Madrid (2015) are two further examples of the developing interest in data visualisation within the arts.

Works such as EXIT (2008 - 2015),[51] draw on a number of sources for the data including climate records, and meteorological data. Further recent artistic projects taking a global view of big data include ‘On Broadway’ (2015) by Lev Manovich and his collaborators, including Moritz Stefaner, which employs data acquired from a variety of internet protocols and APIs, including Twitter, Google Streetview and Foursquare.

What these more recent projects have in common is the use of mixing data from networks. Within this field this recombining of data demonstrates the effects of humans

[51] A huge undertaking developed with urbanist Paul Virilio commissioned from the New-York based art–architecture team Diller Scofidio + Renfro, in collaboration with significant media artists Mark Hansen and Ben Rubin. EXIT does not look like art; it is corporate in its visual language, even though it is on exhibition in an art gallery environment and was commissioned by Paris’s Cartier Foundation for contemporary art. https://www.fondationcartier.com/en/collection/artworks/exit

on the environment, climate change, while attending to a sense of impending apocalypse. These real-time systems contexts are embedded in politics, in surveillance and in art.

2.7 Smart cities and future systems

Definitions of cities and technologies can now include the e-city, electronics city, intelligent city (a title used in the exhibition The Intelligent City for Bruges Museum - Stanza 2015), cyber city, media city. Various other authors have also coined lists of descriptions. IoT City (Manchester City Council) Smart City, Digital City, Cybercities, Sentient City (Willis and Aurigi, 2017, p.7).

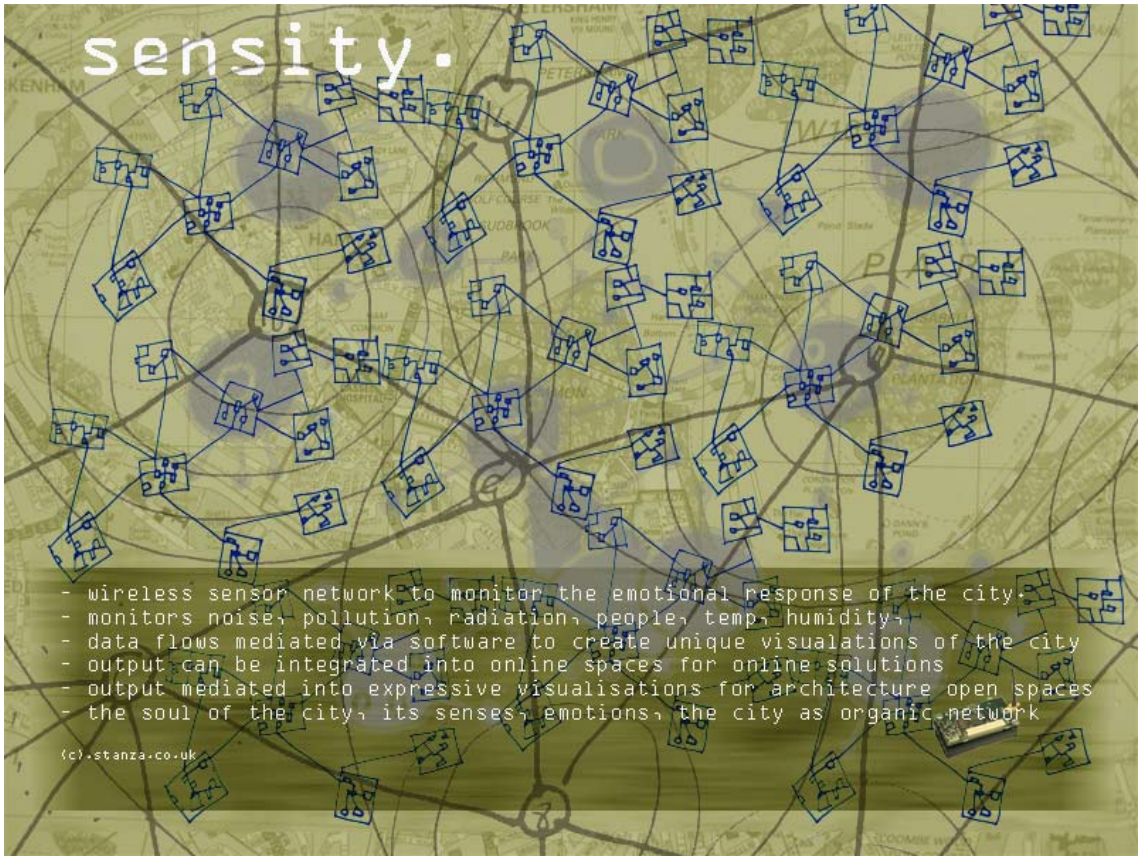


Figure 10: Diagram of surveillance in the city (Stanza, 2004)

These varied terms to some extent also offer some parameters to unlock and

understand the artworks and the research contribution and impact they make across disciplines. However, it is the term ‘sentient city’ (Shepard, 2011, p.20) a city capable of sensing and reflexively monitoring the environment and our behaviour that most accurately resonates in describing Sensity in 2007. The word sentient could be used to describe a city that can perceive or feel things that makes it possible to be aware, where everything is understood as mobile and in flux; to enable a new landscape that can be seen unfolding in time. This suggestion leads us to be able to create maps of the city via our movement as cities become a means of revealing new things. The artistic intentions respond to such events and activities via data as they happen in the performative city and can now represent them with new metaphors that describe the world through these complex systems. What we see are spatially variable surfaces which are malleable and contain data about themselves, and which link to other data. Data therefore becomes the material of the artworks as it is extended into the virtual plane. This can be experienced in the form of maps with hybridised layers of interacting data sets (see Sensity section 3). The prevalence of such numerous artistic data interventions suggests 'data has become the medium of the age' (Stanza, 2007).

The terms u-city or ubiquitous city have also been adopted in describing this expanded technological urban landscape where sensors embedded in the city would create new IT infrastructure for even more systems such as parking traffic and crime prevention (Kitchen, 2018). The intention was clarified in the book *'City Of Bits'* where Mitchell (1995) states: 'Our cities are fast transforming into artificial ecosystems of interconnected, interdependent intelligent organisms'. This succinctly describes the organic quality now enmeshed and interwoven in what the concept of a city is.

The city becomes a digitally controlled machine where single interfaces allow a single point of control. David Gelertner writes: 'When you switch on your city Mirror World, the whole city shows up on your screen, in a single dense, live, pulsing, swarming, moving, changing picture' (Gelertner,1993, p.32). Here we see the city itself becoming an abstracted vision of itself, an abstract platform. This aliveness, this transformation, draws our attention to the ever-shifting mood of the city much like the artwork The Nemesis Machine (See Section 6)**.**

Although not connected to art or surveillance, a key reference that has shaped this work and the connection to cities of networked electronics and the contextual development of *The Emergent City* was Dennis Compton's book *Computer City'*(1964). In this, Compton expands on how Archigram proposed a responsive town which was a metropolis with electronic changeability. Importantly *Computer City* carried some of these principles and further developed these ideas and the theories of Norbert Wiener,[52] suggesting the city was a relational and responsive network.

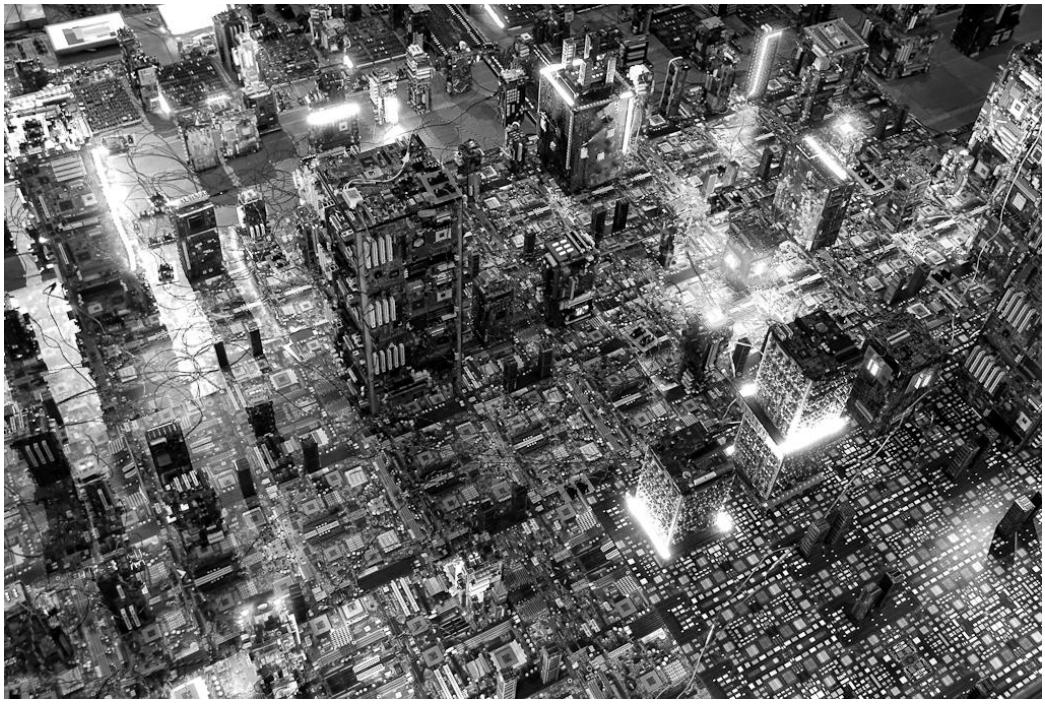


Figure 11: The Nemesis Machine (Stanza, 2017).

For Compton the proposition was a concept of a city which listens to its citizens in real-time via sensors, and real-time communication via a brain to keep people informed and therefore control its design. This interaction was articulated in the book *'The Urban Place and the Nonplace Urban Realm''* by Melvin Webber (1964) who states 'interaction and not location, is the essence of the town and life of the town'.

[52] Norbert Wiener was an American mathematician and philosopher considered the originator of cybernetics. Cybernetics: Or Control and Communication in the Animal and the Machine is a book written by Norbert Wiener and published in 1948. It is the first public usage of the term "Cybernetics" to refer to self-regulating mechanisms.

Therefore the problem for city developers becomes how can data be formalised and represented across these flowing networks, and for the author who is contextualising the work as art how can meaning be extended in this case into the visual as new media art? If the data is formatted as informational design this would be witnessed as smart city dashboards and control rooms rather than within artistic contexts where it can be formed for the purposes of agency, or performativity. For this purpose and in this example by actually building the artwork The Nemesis Machine as a literal computer city we witness this interactivity as a relational layer as well as the all seeing panoptic eye, thus further demonstrating agency of the city, the data, the network.

Arguably, the technology itself (wireless sensors) is changing urban patterns and a relational shift is created in this work by producing new artistic experience and interpretive knowledge via these tools, which also allows for a better understanding of the urban domain. To know the data is there is one thing; to see it made real and performing is quite another. This shift into the algorithmic control of 'observable' space also affects planning decisions and allocations of resources, which we are now coming to witness through information led data visualisations (see ESRI[53])**.**

Another concept developed within the research enquiry is that future cities will be merged into real time connected up data cities. Not just one space, but a connection of networks and of real-time information flows, thus further blurring control and surveillance capabilities. The suggestion is that there is a new social space of untapped collaborative possibilities that exists in between these independent networks. This is evidenced in the published work and the machine-like city work The Nemesis Machine.

The results which elicit the unique contribution to knowledge which are created are the fused mashed-up data cities and real-time performative city experiences, all re-presented as systems of control. The process of engagement allows one to become

[53] Esri is an international supplier of geographic information system software, web GIS and geodatabase management applications.

aware of one's actions in the system and the complicit nature of this behaviour. It is the relationship that is key to unwarping the multi-disciplinary layers that the artwork is communicating.

The real-time experience of data allows new ways of understanding the way the world is built and designed now and in the future, and is evidenced in the multidisciplinary nature of the artwork (See Section 3).

The new city data spaces are ‘smart cities’; the artworks cross boundaries creating a transfer of speculative knowledge from art to urban theory (Kitchen, 2018) and big businesses such as Cisco Systems[54].

Between 2014 and 2017, we have witnessed the emergence of technology such as Libellium and Cisco smart cities that allows city officials to interact directly with both community and city infrastructure and to monitor what is happening in the city and how the city is evolving (Ibid, 2018). The former separation of networked technology from that of surveillance systems no longer exists; it is context that draws out the meaning, as evidenced in these artworks.

In this context smart city developments are now government funded and taking place across the globe, addressing many different issues, citizen empowerment, data for traffic systems, utility information. It is similar data, where implicated context leads the objective, drawn from the intended methods. It is the shift in context that allows the shift in meaning. In the author's case, it is the cultural uses of data-sets witnessed in the published artworks and the implied meaning that one understands once the artworks are experienced.

Within The Emergent City and subsequent projects, the intention back in 2007 was to take a step towards the *'City of Bits'* (Mitchell, 1995) spotlighted as connected virtual

[54] Cisco Systems exhibited The Nemesis Machine by Stanza at the Internet of Things World Forum at Tobacco Dock London next to their mewly developed smart city API which they development in 2017.

spaces on the superhighway dominated by software rather than material.[55] The connection of networks of real-time information flows are made tangible demonstrating the possibilities for other novel artistic experiences. It is this shift in context the author explores and exploits in the sonifications, visualisations, and sculptural objects called, 'The Emergent City' — thus demonstrating the malleability of the source material, the data. The data themsleves are the material of the art evidenced inside the flow of the systems. It is these implied connections the artworks seek to evidence.

Dewayne Hendricks states: 'We've connected more people, but we haven't connected more things yet; we're getting a convergence now, but what's missing are the people that are advocates of this intelligent device stuff.' [56] This is addressed by creating artworks that harness the agency of the active living city. These artworks also act as prototype demonstrators for smart cities while at the same time become spectacular media art pieces where audiences can engage these deeper conversations, effectively connecting the dots. The Nemesis Machine can be summarized as an experiential art installation or art city where ‘data power the wind turbines or where the data changing the solar panels also change the lights’ (Bullivant, 2006) .

This interest in connected devices is starting to appear in other sources. Rob van Kranenburg 'imagines a world where everything reformulates our relationship with objects as well as the objects themselves.'[57] The author's vision to connect up the whole city space for an artwork representing the city is now also a business model. For example Smart Santander have proposed a city-scale experimental research facility in support of services for a smart city (2010).[58]

These projects engage with the city as a system of layered information flows. In this context, given that the urban environment can stand as a good model for the complex interactions and relations that thinkers such as Bruno Latour (1998) see as governing

[55] The Emergent City projects and research practice approached this using mesh sensor networks across space, collecting data during many of the artworks. Throughout the author speculates how future cities will become merged into real-time connected up data cities. The modernist city becomes connected via pipes, roads, and infrastructure.
[56] Dwayne Hendricks website no longer online but referenced http://www.stanza.co.uk/emergentcity/?p=1267
[57] The Internet of Things EU. http://www.theinternetofthings.eu/
[58] Smart Santander http://www.smartsantander.eu/

our world. Indeed Latour in *'Paris: Ville Invisible'* makes this exact point. In this book he describes the highly interconnected and often hidden structures of the city of Paris, in order to demonstrate the degree to which what we see of a city is only a very small part of a far more complex situation.

The author's aim was to create new meaningful experiences allowing critical reflection on the real-time city and the socio-political undercurrent currently embedded in the search for the real-time city (Marchese, 2015, p.207). The artworks Sensity (2006-2009), House (2007), Sonicity (2010), Capacities (2010), Body (2013) are all made using interconnected networks of real-time information flows. The city is now living, a complex time-based network; it is 'alive with movement and excitement, a rapid flow of exchange facilitated by a meshwork of infrastructure connections. In this environment, the internet has advanced to become the prime communication medium' (Foth, 2008). The artworks are developed and sited and experienced on the internet. This creates a new novel narrative inside this new virtual space, and as data-cities merge they overlap one another and can become interrogated by new questions searching for new knowledge. By focusing on the open online visualisation of the city as a data-space the focus can shift away from this 'promise' because, as the author suggests, one cannot avoid mentioning the control and the ethics of data being manipulated, which is central to this thesis. This now positions this practice and these new media artworks in relation to the ethics and ownership of data and investigates the city as panopticon. The whole city becomes a control space and is explored in the artwork The Nemesis Machine – From Metropolis to Megalopolis to Ecumenopolis (2010 - 2017) (see Section 6.0).[59]

2.8 Conclusions

This contextual review examined literature relating to strategies of surveillance and dataveillance media art, and the smart city, as well as concepts relating to surveillance and performativity. It's a broad spectrum of investigations that channels knowledge into the creation of the artworks.

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[59] The Nemesis Machine project website http://stanza.co.uk/nemesis-machineweb/index.html

The interdisciplinary weave of these disciplines is now demonstrated as a global model that has affected the practice and the artistic outcomes. Namely this interlocking model explores environmental data and how it is built into technological systems in real time, after which data is collected to be interpreted before finally newly fashioned experiences and artworks are made. These artworks suggest and address a critical inquiry through the projects related to surveillance studies, networked cultures and real time systems.

In the next section projects are described that align themselves with the research questions as well as these underlying themes of panoptic aesthetics, and the surveillance space (the city) with which we complicitly interact and interface.

3.0 Public Works or Outputs

Creating novel artistic interfaces for public engagement of environmental data-spaces

Included below are the context, introduction and methods for each project as well as the production narrative, research insights and conclusions. These public works are discussed in Sections 3, 4, 5, 6. The outputs are in the Digital Volume. In the folders 'WEBSITES' 'EXAMPLES' AND 'EXTRAS' and there is a 'readme.txt' to explain where everything is. The key works where methods are developed are Sensity (Section 3) and The Nemesis Machine (Section 6). Other works (Section 4 and 5) support an iterative artistic process which leads to new outputs.

The selected published artworks cross over into the subject areas of urban studies, computing and fine arts to become part of an interdisciplinary approach to artistic practice based research. These projects all have common themes that reflect on privacy in data networks, identity loss in the digital domain, the control and ownership

of data, the investigation of public domain environments as cultural spaces, as well as incorporating real-time events and experiences across distributed city-wide environments and systems.

Placing these issues in a much broader context, these art projects and related research inquiries set out to exploit the changing dynamics of the real-time city as a source for creativity whose aim is to create meaningful artistic metaphors utilising new technologies. The outputs are then reintegrated into the public domain as new media artworks, as part of this ongoing research into the visualization of city space (the environment). Critically underpinning these digital media artworks and research agendas is a further series of potential questions about observation, surveillance, and the ethics of the control space, also discussed and investigated in parallel.

All the digital artworks that follow in this section therefore develop ways to collect, present and interpret data embodied in the city, creating audiovisual media artworks while incorporating the findings of this research into the artworks produced. Common to all methods in the development of all the artworks produced is the data collection technology; a wireless mesh sensor network which is laid out across the city to collect and monitor data. To put this in context, various sensors at any time are surveying and creating information relating to temperature, light, pressure, noise, humidity, GPS, and the sound of the city in a real-time network.

The published works are listed as projects and are in the following sections.

In Section 3 works are explored in terms of the surveyed and monitored landscape as a liquid flowing data space, demonstrating specifically how insights through the development of the distributed mesh sensors across the city led to online real-time data visualisations and gallery exhibitions. The author's methods are expanded in Sections 4 and 5 through several developmental iterations which included harvesting data from sensors placed in trees to to sonify the data, thereby creating musical expressions for the real-time environmental data. And in Section 6 the focus returns to panoptic surveillance in a sculptural installation focused on addressing who owns data

while reflecting on our complicit relation to the performativity of the wider city space.

3.1 Sensity (2006 - 2009)

A series of digital artworks sensing the invisible environment based on connecting city spaces using sensor networks.

The project is in Volume 2 as a local version of the website (See V2. WEBSITES 3.1 and V2 EXAMPLES 3.2 where you can click on the swf file for the interface or watch a video).

The Sensity art projects and exhibitions represent six years of critical reflection on the ownership and creative use of environmental data (light, temperature, noise, sounds, GPS, humidity) within larger systems that seek to disclose invisible patterns and behaviours, unfolding these data changes in real-time. The idea here was to give tangible form to this new space, the space where the data environments can overlap, thus presenting an alternative urban virtual environment, a visual layer of the real-time city that is experienced by an online audience. The online interface facilitates remediation of this data by linking up the virtual spaces as a series of layers across distances. In the visual prototype (Figure 3-1 below), the audience sees the data made visible as a morphing form on the screen.

The Sensity series of digital artworks is informed by methods and processes of live data collection that sought to conceive of new ways to represent city environments using novel ad hoc sensor deployment. The stated aim was to mediate real-time data into digital artworks which respond to the ‘city' and its concurrent, measurable sensory 'behaviours'. A series of aims were defined, which focused on access and analysis of the available data relating to urban spaces. These are defined within each section through more detailed research questions that lead to research insights which are summarised at the end of each of these sections.

The practice involved developing new artistic representational forms of city

environments using real-time data collection techniques, using sensors to explore how these approaches reveal the city as a system of normally invisible hidden phenomena and systems. Finally, the resulting artworks are presented via online networks creating new bespoke systems and platforms, also creating a commonly owned data platform.

The artistic proposition made is that this specific virtual space belongs to us all as public domain space, and the data can, therefore, become commonly owned. Thus, the suggestion is that these data are, in fact, currency and the project distributes this value freely, even if it is only cultural. The project entailed the creation of this artistic platform and shared the online real-time feeds. By doing this, the idea became evidenced within the freely available collaborative tool or platform.

Further intention and practice-based approaches embedded this work within other overlapping media art contexts. This includes surveillance of the city using new technologies, in this case wireless sensors. Exploring the data as an exchangeable commodity as its inherent value for new understanding, in relation to panoptic aesthetics, is critical. This was achieved by investigating the control and manipulation of these data and the outputs, in relation to the artistic context and how it can be experienced. Sensity also impacts other fields of practice, for example, the areas now known as smart cities and the Internet of Things (IoT).

The simple navigation system also gives real-time control of the data system to the user. This novel approach of handing control to the audience allows for a critical reflection on the fluidity of real-time city, as a space that can be controlled and manipulated.

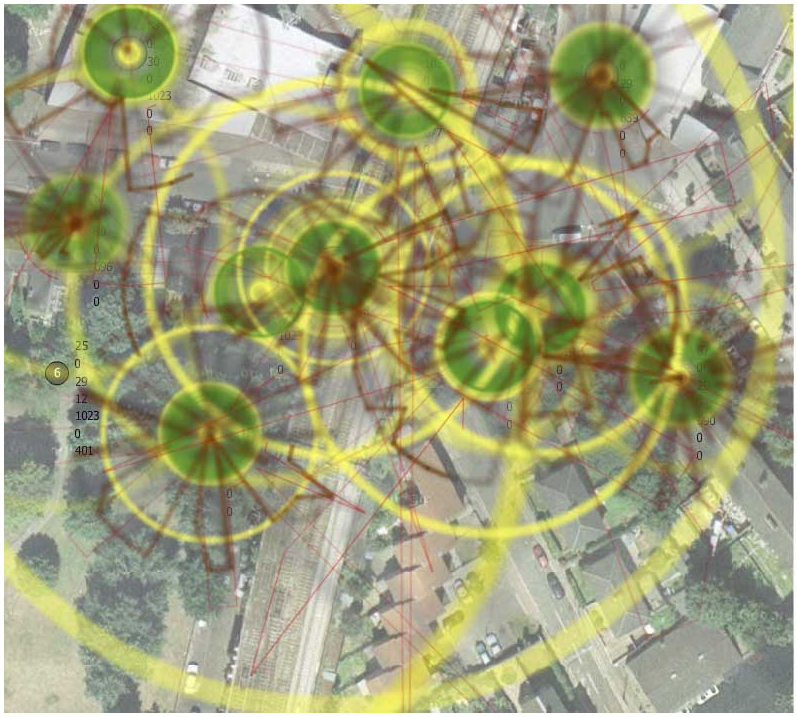

Figure 12: The first data visualisation from Sensity, Brixton (Stanza, 2004)

These data were used to generate animated visualisations experienced online as new media artworks and presented internationally as artworks in selected international galleries including V & A London (2008) and Pace Digital Gallery in New York (2010), which were among twelve exhibitions (see Appendix) in various venues globally that could also simultaneously be accessed online via the interface.

3.2 Research Methods and Development

The artworks produced have several overlapping research methods that support the aims.

The first method developed involved a *technical approach* to data analysis or surveillance, based on ideas of the panoptic. By deploying dozens of sensors in the city environment in order to survey the landscape and enable the collection of real-time data, technical data was reinterpreted using a rigorous, but non-scientific, analysis. It was the deliberate intention to suggest that by scattering and monitoring the city using

‘smart’ sensor technology and by making novel platforms this observation becomes in itself panoptic (Foucault, 1975). Therefore by actively deploying sensors in situ for each exhibition, the whole concept of the city as a machine-like panopticon cannot be avoided. The Sensity artwork in this respect is a responsive observing system from which users can all see the changing outcomes. Everything is connected to everything within a more extensive system of control and everyone is complicit in its creation by default. There is a perspective shift from the single user single perspective panopticon to a multi-perspective, multi-user perspective as we can all see everything all at once in the system.

This research method was therefore designed to support software to enable an iterative *user interaction* with the audiences, so that the work could be adapted during development. For example, interpretive maps with generative animated shapes represent the changing monitored system. When the audience starts clicking on various aspects of the interface it is possible to analyse shapes that are generated, growing and moving as animations concerning the data changes (see fig. 12). This interaction becomes, in essence, a poetic interpretation of the data. This principal aim connected the notion that everything we do can be mirrored by another system alluding once again to the idea of a global panoptic experience in which everyone is just an observable unit of data or a commodity.

In the following passages, a description of the development of these works includes reflection upon the successes and challenges of these methods.

It is worth noting that the methods ensure that the outputs reach a global audience, creating a new interpretation of how networked cities in the future can be shared in real-time alongside events that are happening at the point of access. In these cases in the form of noise maps, temperature, light, pollution and sound, via the feeds and in the form of any visualisations created.

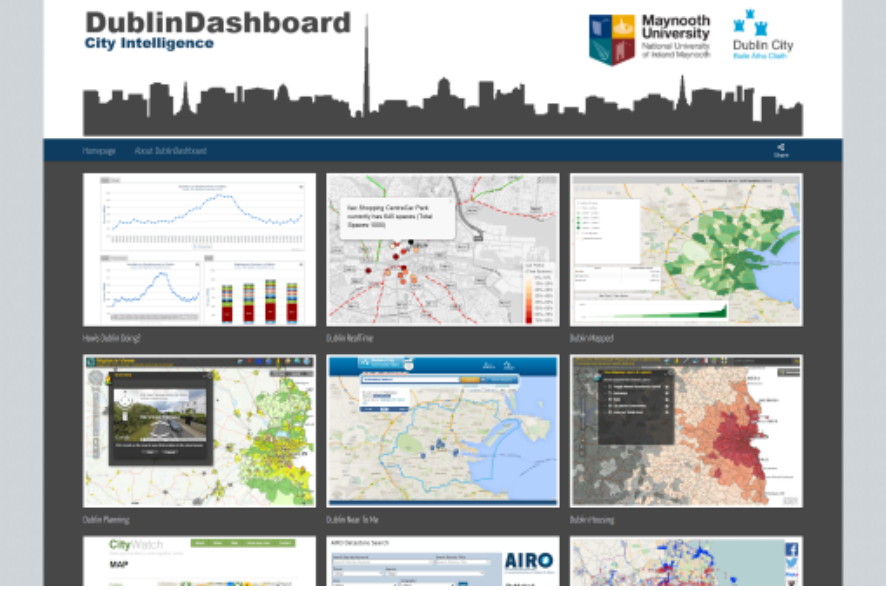

Figure 13: Dublin dashboards.Screenshot taken from website (2018)[60]

Lastly, as with all of the artworks, the project is to create an *experimental* prototype, a demonstrator for exploring the field of data, familiar to many disciplines such as computer science and data analysis, which in turn could impact on how we see the world of smart cities and the Internet of Things.

Such developments are now evident in many smart city dashboards that have appeared in the last five years (2014 – 2019); examples include Dublin (see above) and Barcelona dashboards[61].

Sensity[62] (2004 - 2009) was initially developed outside the timeframe of this study, but early developments became critical to developing the research methods that underpin the series of artworks under review, and were created by connecting a variety of city locations all at once using wireless sensor networks.

These early outputs led to nine online software visualisations of real-time spaces (that do fall under the scope of the timeframe of this study) using selected customised

[60] The Dublin Dashboard allows users to get detailed and updated information about the city that helps decision making and encourages evidence-informed analysis. https://smartdublin.ie/smartstories/dublin-dashboard/ [Accessed 14 Oct. 2018]
[61] Municipal Dashboard Barcelona Digital City. https://ajuntament.barcelona.cat/digital/en [Accessed 14 Oct. 2019]
[62] Project archive for Sensity. http://stanza.co.uk/sensity/index.html

wireless sensor networks and environmental sensor technologies. The outputs also included online interfaces, the online data streams and the experimental installation / prototype artwork shown below.

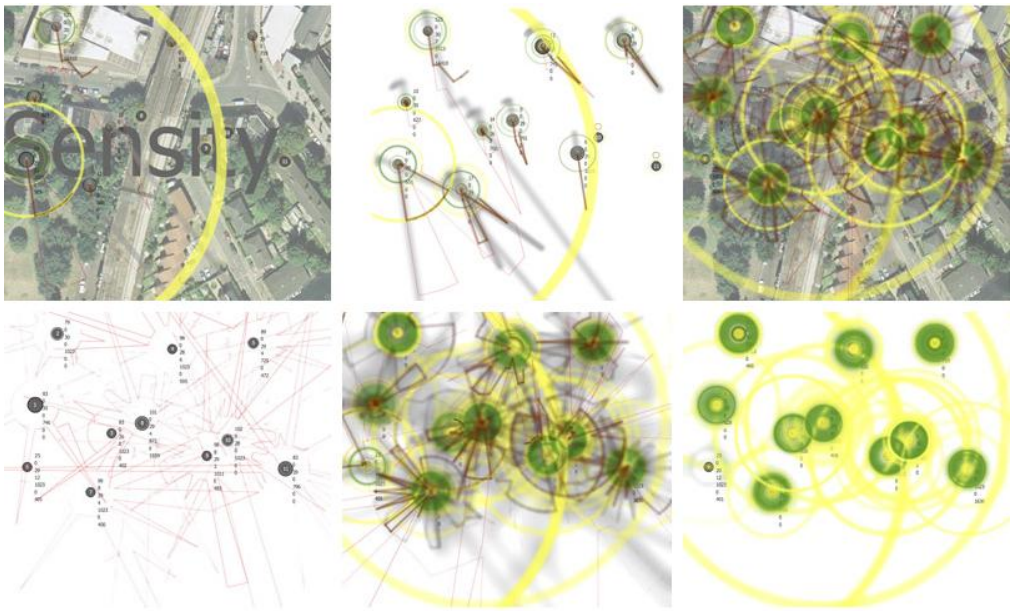

Figure 14: Sensity Brixton. Interpretations of computer code (Stanza, 2004 -2009)

In the artwork visualization given the title 'Sensity Brixton' (Fig: 14), the dynamic data around South London SE5 is captured using the deployed *motes* wireless sensor network. Individual sensors are in the park; a railway line, a factory, a phone mast, and in a tree. Clicking on the images online activates the artwork. The slightly blurred images of the locations become covered with puffy clouds of 'data' moving out from the points that mark the locations of the sensors. It requires time to understand that this represents the change in the data. Numbers form and then change, always offering a sense of movement creating the possibility to see the multi layered network as a semantic representation evolved by the network.

Possibly the most ambitious outcome was the invitation to realise this at the Victoria and Albert Museum, London. The version titled 'Sensity V&A' was commissioned for the Decode exhibition (2009) which featured an international set of new media artists exploring the themes 'Code as Raw Material, Interactivity and The Network'. The theme

network focused on works that comment on and utilise the digital traces left behind by everyday communications, mobile communications and satellite-tracked GPS systems. The Sensity V&A installation used twenty custom environmental sensor mote units[63] in the Porter gallery measuring light, noise, sound, humidity, temperature and GPS. It was simultaneously shown on a developed Google map using the Google API also inside the gallery for the duration of the exhibition, but is no longer supported or available because the sensors need to be permanently left on and this is not cost effective.

The audience could see both the sensor data and the placement of the sensors and the visualisation creating a novel way to see and experience the gallery and the micro activities of the surroundings as well. Although presented as a media artwork nearly a decade later very similar visual interfaces are being incorporated into the design of many smart city developments, i.e. data on Google maps and city dashboards whose aim is city governance and within large control rooms.

Figure 15: Installation shot from V&A Museum, London (2008)

[63] A sensor node, also known as a mote, in this case each has light, temperature, noise, and sounder board. Others including MTS420CC used GPS and pollution sensors. Most sensor nodes are small in size, consume little energy, operate in high volumetric densities. Reference https://www.willow.co.uk/MOTE-VIEW_User_Manual_.pdf

http://igor.gold.ac.uk/motes/mts420/motestatusxml_html.php

```
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        <moteid>1</moteid>
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        <seconds>0</seconds>
        <latitudeminutes>0</latitudeminutes>
        <longitudeminute>0</longitudeminute>
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        <fixed>0</fixed>
        <lightval>65530</lightval>
</mote>
```

Figure 16: Example of feed from the server hosted at Goldsmiths College (2007)

The online interfaces which are the artworks become networked in an even bigger system of control monitored over the internet. The changing real-time data become observable in this extensive connecting system of technology. The online users are interacting with the real world via the interfaces and can control and alter the visible layer of data and can manipulate the system. By linking up all the cities in this way, the whole world could become one dynamic real-time artwork monitored online.
The Sensity artworks thus become a system for connecting everything. Technology developments are fuelling the global Internet of Things (IoT) into what Cisco now describes as an Internet of Everything[64] (2013) demonstrating how an interdisciplinary reach outside the gallery operates today.

The technical research methodologies required lengthy experimentation with wireless sensor technology; exploring and evaluating continually as well as combining the

[64] Internet Of Everything. https://www.bbvaopenmind.com/en/the-internet-of-everything-ioe/ Accessed. 8.8.2019.

aesthetic development of the platform's output, i.e. the media artworks. The author's role in this project was as artist and designer while also being responsible for resource gathering, management, dissemination, analysis and evaluation as well as exploring and expanding the uses of new technologies, and authoring computer code.

Additionally, Sensity provided a reflective space for new technology and new media art while generating new ideas about the experience of these data, mapping, and open artistic platforms. Primarily the deployed technologies monitor selected areas of the city over time and build collections of data whose aim is to understand the city as a time-based complex system. What is happening, in essence, is that the real world is being represented as a virtual visualisation online; the city is representing itself through this newly created network.

By 'polling' these data in real-time, the performance happens over and across the network. As the real-time data become parsed through online systems, they become a flowing stream of data (numbers) from the environment that is now mirroring the real world from where the data is coming. Visitors to the website experience this artwork in real-time. The image (Figure 12) shows a localised version of the interface. It took several years to refine and develop a practical method to make it real-time, as will be explained in the following section.

3.3 DevelopIng Technology Methods (2004 - 2017)

A crucial conceptual objective of this research was to develop material in an open data format. The XML feed was made available on the website www.stanza.co.uk when the sensors are switched on and in real-time. These live feeds could not only be shared, but their inherent value as a commodity would also be shared. The notion of this virtual public domain space as a property with any associated concurrent value is presented to be commonly owned and available for all. This action supports the primary objective to make the virtual digital artworks and the secondary objective to make it freely available as a commodity. The suggestion is that the virtual space becomes owned by

the citizens. Control to access the hardware was made available to create visualizations in an open-source environment; control of the system becomes distributed. In presenting the results and the digital artwork online in this way instead of as an installation or archive, it allows this global experience of shared ownership. Also by allowing others (artists, academics, anyone) to access the online feeds, it meant other online users were given the possibility to re-interpret the data and interrogate the various sensors in the network via XML and PHP.

Whilst the initial development of the technical research was grounded in work undertaken beyond the scope of this study, however it is useful to understand how the appropriate method to create these aesthetic outcomes was developed in order to use wireless sensor technologies, so that a platform could be developed to manipulate the open data in later projects (From 2007 onwards).

The first step was to develop a data collection system utilizing technology to test some of the stated objectives relating to monitoring citywide environments, ownership and control of data. The initial problem was deciding which hardware to use that could meet the stated aims. None existed that worked straight out of the box. During an earlier Nesta[65] Dreamtime Award which the author received (Stanza, 2004) one of the projects conceived was a city-wide surveillance monitoring system using sensors. This concept was presented to Nesta (2005) and to Goldsmiths College Centre of Computing and Centre of Urban Studies (2006) in conjunction with Professor Janis Jefferies who encouraged the pursuit of a successful AHRC creative fellowship. It was during the fellowship (Stanza, 2007) when methods for the online platform were developed and the real-time online system was first deployed.

To give this some context, wide-ranging online articles started to appear in technology journals about cities scattered with sensors called 'smart dust'[66] (2000 onwards). However many other technology players had yet to come to the market not least

[65] Nesta. The Innovation Foundation. https://www.nesta.org.uk/ Stanza was granted a Dreamtime award in 2004 this enabled the first prototype. This award no longer exists.
[66] Reference to smart dust from 1997 onwards at Berkeley. https://en.wikipedia.org/wiki/Smartdust

Arduino,[67] and a whole myriad of other micro-electronic prototyping boards and numerous smart cities development kits from companies like Libelium.[68]

The work initially focused on creating any type of network to facilitate the ideas, concepts, and project aims; and as part of the project development, a wireless sensor network was set up. In brief and in order to give some context to the process the wireless sensors which are called motes run with Tiny OS, and are open source. In order to get to grips with this technology visits were made to Crossbow[69] Technology in San Jose USA (2004) funded by the Nesta Dreamtime Award and Boston USA (2004) for workshops and a visit to the culture computing lab at MIT.

Initial tests for the sensor network were deployed across several physical spaces (both at The Watershed Media Centre Bristol, and Goldsmiths Digital Studios, London). The primary research was to be based on analysis of technical tests and also through playful experimentation with the technologies used.

The mix of procedural development and evaluation through practice was the adopted research methodology based on the assumption that technologies will change. Initial problems included the length of time to deploy and learn to program the sensors. The next hurdle was to get the data from the sensors onto an online environment. Initial preparation was made to adapt to new technologies by keeping the research path open, but this proved too costly once the practical work started.

Up to forty sensors communicate with one another via radio signals across the mesh network. They re-configure themselves or self-heal, so that the network stays stable. Each mote can sense its position, wake up and find its neighbour in the network. The sensors have high energy use, and this is a significant problem in using them and depends on how they are programmed.

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[67] Arduino. An open source PCB board that came to the market in 2005 which was started at the Interaction Design Institute Ivrea (IDII) in Ivrea, Italy. https://www.arduino.cc/

[68] Cloud based sensor computing http://www.libelium.com/ Accessed 17.10. 2017

[69] Crossbow was one of the first suppliers of Berkeley-style MICA sensor nodes that it called "motes". Definition.wikipedia.org/wiki/Crossbow_Technology Accessed 17 Oct. 2017

Initial problems encountered that needed to be overcome to meet the project objectives included the fact that the technology did not work, as promised, as an out of the development kit. It took two further years to get the sensors to work. These problems were documented on the website at the time (See Sensity V2. 3.1).

After lengthy consultation with Imperial College and Goldsmiths College Computing and technology manufacturers, the conclusion was that the XML-RPC functionality of the system did not work. Since the primary aim was to have an open system of hardware and software note only to make the artwork but also to test scenarios of open networks, open data, and systems of control online, this was a significant stumbling block that set the project back two years. In the end, the only way to achieve the objective was to set up an open platform, by creating a proxy server to connect to the online platform via PHP[70], after which the data feeds became available publicly.

In order to interpret the data visually, two versions of the Sensity interface software were made in Flash. One works with recorded data (a sampled piece of time) and one (more important conceptually to the project) that works with the real-time data (i.e. ever-present, always changing, always in the moment), which means the sensors are switched on always and working through the router. Solving this became the main technical challenge of the project. The rationale of the visualisations and aesthetic was to get any real-time change to affect the variables in the online representation so it could appear in a poetic way that the data changes were in effect allowing the forms to grow and change.

Research Insights

The forms in the digital artwork relate to the idea of a city in constant flux, like an organic system. The insight being that the city is alive, from a poetic perspective. The online interfaces are controllable by the online audience who can if they wish remove

[70] PHP is a general-purpose scripting language that is especially suited to web development. It was originally created by Danish-Canadian programmer Rasmus Lerdorf in 1994.

all traces of the underlying map to view an abstracted morphing animation. The data becomes a visual abstraction of the whole city and all the layers above. Acting on the city was a matter of sensing and actuating; the whole city shows up on your screen, in a single dense, live, pulsing, swarming, changing picture. What we are left with is a codified system that represents the social power of the interactive city as a system (Gelertner, 1992, p.32). Sensity maps because of their multi-sensory and multi-positional reflection are more than *'Walking The City'* (Certeau, 1980).

3.4 Insights. Discussion of Findings and Outputs

Changing real-time data affects what the audience sees and experiences. The custom-made flash interfaces online reflect these real-time changes in the interactive city space. There are live XML feeds from sensors when switched on. The feed is open source so other academics, urban designers, researchers as well as artists can make use of the data. Whilst in context, this idea felt novel, topical and timely (2007); this approach to open data has since been employed through numerous types of API development as ways to exploit value systems have been recognised.

The fluid / liquid data sets become performative agents reflecting the real-time social change, reflecting a society where space can be re-formed as monitored data space. The suggestion is that the city is a living breathing system, a fluid space that performs itself and is experienced through the data. This virtual performance can be analysed or visualised as it evolves in real-time; this gives an insight into its dynamic quality as data is always moving, changing, and shifting into the next expression of itself. The expression and experience of this concept suggest this aliveness. The city can thus be suggested to be an emergent or living organic entity.

The city was potentially a digital machine or a digitally controlled one (Willis, Aurigi, 2018). It is this monitoring of the data that aligns itself so closely to the censored, controlled, surveyed. The negative potential exerts its tension against the open, transparent system built in this artwork which suggests that virtual space is also

in the public domain, while asking to whom does this virtual space belong? Saskia Sassen[71] had repeatedly described cities as incomplete systems but this does not seem to matter if we acknowledge that 'our cities are fast transforming into artificial ecosystems of interconnected, interdependent digital organisms' (Mitchell,1995). This is 'all netted together in a web over the world, a global nervous system' (Gibson, 1984, p.17).

The panoptic aesthetic is fused with poetic interpretation. Lines that shift and move, that are organic and alive, disclose the invisible and make real what is intangible. The algorithm interprets the data that creates visual experience that creates the artwork - an organism of city data alive and of itself.

3.5 Conclusions

Sensity was developed to offer a rich platform through which we may better understand the urban landscape by increasing our knowledge of the ebbs and flows that occur and allow thinking in visual terms and uncover unknown territory. However, the network is not just technical. Sensity gathers real-time data merging the physical city with the digital city, overlaying representations in virtual space showing how this invisible agency is created, which is by default affected by us all.

Furthermore, these data may be used to interpret experiential aspects of the city, exploring its characteristics and their flux by creating visual concepts of what a city might become, especially in relation to how any data gathered will be used and interpreted to enable feedback via the virtual world to inform the real world; or how the real world informs the virtual. It is this constant change that becomes most relevant in the interpretation of the artworks. Each project is embedded with an environmental flux of fluid data that takes into account the concepts of the city as an organism (Lynch, 1960) or as a city made of bits (Mitchell, 1995) and can be seen as a more sophisticated layered totality, embedded by new technology.

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[71] 'The Incomplete City Strikes Back - Saskia Sassen'. Accessed 14 Oct. 2017. http://www.saskiasassen.com/PDFs/publications/the-incomplete-city-strikes-back.pdf.

Sensity exists to breathe life into the map and the city and to draw parallels with emergent properties of the city. The Sensity artworks align themselves not with, but at a tangent to, Situationist International (SI)[72] by seeking an experiential societal value, but they quickly move into the participatory managed, real-time, and monitored. It might be interesting to further contextualise the Sensity map interface in terms of psychogeography with the playful drifting of the amorphous shapes within the interface allowing the allusion of the flaneur. This interpretation allows the viewers to wander into the hidden or invisible spaces that the floating layer of data now makes visible. This suggestion allows the technology to aid this process delving into the soul of the city; something the author also tangentially explored in an earlier work Soul (2004).[73]

'The integration of digital technologies with the public domain reveals further relationships, and as such the datasets Stanza examples provide catalyst not only as a creative medium in themselves but as instruments to inform new urban experiences' (Brook, Dunn, 2011, p.108).

More and more calls from arts media organizations during this period show increased interest in the interactive city. Here is one from the Exploits In The Wireless City Exhibition (2009): 'Our cities are increasingly pervaded by data networks, watched over by cameras, skinned by media facades.'[74] For this event in Nottingham the city became 'a public space where we constantly leave traces of our actions, thoughts and opinions.'[75] The city becomes a complex system of relationships, disclosed by these technologies, mapping the invisible relationships on the city.

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[72] When the Situationist International was first formed, it had a predominantly artistic focus; emphasis was placed on concepts like unitary urbanism and psychogeography. https://www.britannica.com/topic/Situationist-International. Accessed 14 Oct. 2018.

[73] Soul uses surveillance camera networks to re visualize the urban environment. The cameras capture "the soul of the city" and represent these images as a piece of sculpture in a constantly evolving visual sculpture. This data sculpture is a live real time evolving or generative artwork. https://stanza.co.uk/soul_globe/index.html

[74] http://themobilecity.nl/2008/11/07/call-for-submissions-exploits-in-the-wireless-city-radiator-festival-symposium-nottingham-13th-18th-of-january-2009/

[75] Jevbreet, Lisa. Searching Traces Of Web - Mapping Unintended Collectives, Swedish National Public Arts Council Catalogue no 38, (2007)

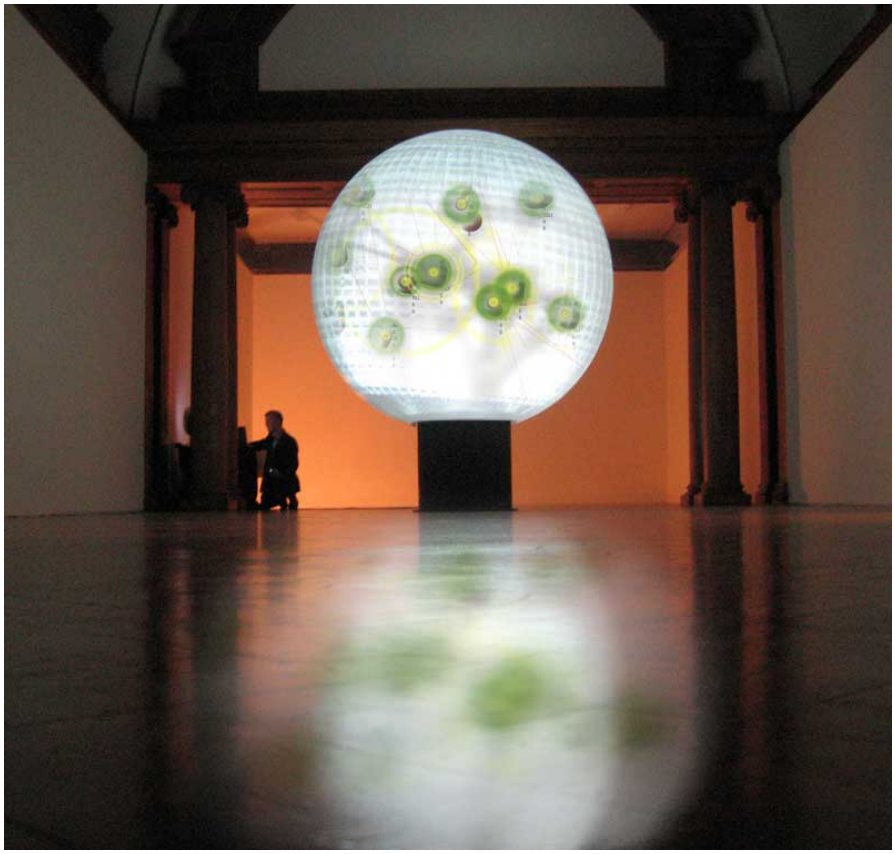

Figure 17: Sensity at County Hall, London (Stanza, 2007)

The author proposed in an interview for The Internet of Things Council[76] that future cities will be merged into real-time connected up data cities. Not just one space, but a connection of networks and real-time information flows. The results created from a cultural perspective would, therefore, lead to mashed-up cities and real-time performative city experiences.

In conclusion, the Sensity series raised questions that allude to how this shared data space can overlap, to create a new space in between, which only two nodes share, a future avatar city. The aim here was to give tangible form to this new space, the space where the cities overlap, presenting an alternative urban virtual environment. What becomes possible might lead to significant breakthroughs in knowledge about the shared data experience that can be achieved through user-based interfaces online, on mobiles, media facades and other platforms (multi-distribution will spawn micro-

[76] Stanza interview for The Internet of Things Council http://stanza.co.uk/emergentcity/?tag=city. Archived on artist's website.

business).

Mark R Hancock stated, 'Sensity can be viewed as a way to challenge or exploit the power balance of state-imposed surveillance systems like CCTV, mobile phone monitoring and car monitoring (for example, cameras installed on buses to monitor the illegal use of bus lanes in the city). There is, of course, an ongoing struggle between the population on one side and the privacy concerns of the population on the other side. Furthermore, if these spaces are public, how much of our surveillance technology are we allowed to deploy?'[77] (Hancock, 2010)

The work poses a further problem not necessarily one of ownership but the implication of control of these systems. ‘Since governments now rely on monitoring information about people this, in turn, makes the apparatus itself more panoptic in nature’ (Dodge, Kitchen, 2011, p.949).

Therefore embedded computing can be considered to be hidden inside the fabric of our lives and our environment, i.e. inside the fabric of the real city, creating a new virtual data city. The real world would become virtualized into an archive retrieval system. The emergent city is, therefore, a sense city embedded with millions of computers, to re-engage with the urban fabric and to enable new artistic metaphors within city space. The artist can, therefore, enhance our experience of city space, as well as monitor the environment, our condition, movement and place within the city itself.

Notes on Dissemination

Sensity was invited for exhibition in over twenty international exhibitions. (see appendix.) The artwork was selected by international curators as part of conversations and debates relating to data, informatics, art, and the real-time city. The work Sensity was also presented at the Force of Metadata Conference at Goldsmiths College 2008 speaking with Lev Manovich and Rafael Lozano-Hemmer. Sensity was used in the

[77] Mark R Hancock review for Furtherfield archived and included in Sensity website see Volume 2 3.1

Goldsmiths College Research Excellence Framework REF in 2009.

During the period of investigation (2007 - 2010), the system was physically deployed in London, São Paulo, Paris, Copenhagen, Nottingham, Austin, Porto, on the invitation of various curators and selected exhibition hosts. Each online interface was custom made for each location and exhibited online, so other audiences could also see and experience it.

Demonstrating the artwork's ongoing relevance ten years later it was exhibited in Warehouse 9 in Copenhagen Denmark 2017, as part of a curated series of city-wide series of art projects where artists have sought to understand the underlying fabric of the city. Cisco systems exhibited the platform at the IOTWF (Internet Of Things World Forum 2017) as part of the artist's other installation The Nemesis Machine (Section 6).

Through a process of iteration the methods developed in Sensity facilitated over ten more artworks, including those presented next in Sections 4 and 5.

Section 4.0 Works remediating real-time environmental data

Introduction

By looking briefly into four more of these projects House (2007),[78] Gallery (2008),[79] A

[78] House. Forces Of Invisible Agency. (2007) Archived here http://www.stanza.co.uk/house/index.html
[79] Gallery. Invisible Agency and Cultural Behaviours. (2008) Archived here http://www.stanza.co.uk/gallery/index.html

World Of New Possibilities (2010)[80] and Data Data Data (2010),[81] this section will ground stepping stones of the research that underpin The Nemesis Machine (Section 6). In particular, it addresses where the research methods and questions had become exhausted that led to the introduction of embodied data in a broader environmental and cultural landscape.

These four separate networked media artworks all mediate real-time environmental data inside selected spaces that included houses, galleries, a National Trust property and the city of Liverpool where a feedback system of data was created across and into the city.

This work included converging raw data streams to facilitate a new connectedness in online networked virtual space. This was achieved by extending the artist's previous research into real-time information and collected data streams to allow further interpretations on the way data is built, used, and designed.

These research aims were facilitated by using the newly developed tools and by using the author's newly created online platforms to experience and represent these spaces online that also provide the context of these art installations and exhibitions.

Furthermore these media artworks demonstrate this context by making the affirmation that our bodies and our actions are at all times part of this bigger system which is referred to here as *the data space*. This was achieved by investigating how these particular spaces[82] can extend the experience of the environment, illustrate temporality, and create a direct connection to our hidden agency in the wider world.

Implicitly, it is argued that there is no longer any escape from the monitored surveyed landscape which has recently been usefully referred to as 'surveillance capitalism', where our personal data has become a commodity in the world of big business (Zuboff,

[80] A World of New Possibilities. (2010) Archived here http://www.stanza.co.uk/possibilities
[81] Data Data Data. (2010) Archived here http://www.stanza.co.uk/data/index.html.
[82] Referring to Lake, Tree, Field the artworks in The World Of New Possibilities series and then in Liverpool for Data Data Data.

2019). These speculative test scenarios, therefore, reinterpret the ever-present flow of data and the creation of a visualisation that demonstrates a new level of understanding of the hidden spaces by combining two or more places at once, as described by the author as the multi-point perspective, while addressing in a broader context the ethical problems of manipulating data and securitisation of the expanding city.

These practical investigations are examples of digital art system experiments, and work as prototypes that test the convergence of data streams. For artistic and technological purposes, all these projects again use wireless sensor networks to create experimental online interfaces which are experienced by the public as new media artworks.

In this sense, testing these new types of interface in this way leads to their use as epistemic tools, of potential interest to other artists, urban planners, noise mapping experts and the broader public, by sharing the resulting data streams that could be used to make, for example, more interfaces for informatics, noise and sound maps for noise pollution, or urban analytics for urban planning; as well as for cultural use and in this case art.

One contextual challenge of this work was to reclaim into the public domain personal information which could become a new currency as legislative powers change. The author asserts this by presenting the data streams for free online. It is argued through these works that common ownership and a sense of belonging to the system could remove a layer of control (Zuboff, 2019), that directs her reader to the control of data trails left behind in networked systems which have become capital.

Therefore these artistic research experiments speculate that social sensing might lead to a new social space, a shared dataspace which can overlap online, with more than one node sharing. The aim here as an artist/ technologist is to give tangible form to this new space, space where the systems overlap, presenting an alternative virtual environment while at the same time thinking about poetic uses of data and their visual representation. The point is to demonstrate tangibly some sense of value, even if

expressed through the context of artistic practice and the agency of participation and shared ownership.

This practice-based research is iterative and experimental both in terms of its cultural and technological innovation. The technological outcomes involved an extra ten different ‘proof of concepts’ prototypes that could be scaled up for future work and possibly also linked up into other API’s and data streams such as the API's now being created for the cities of Trondheim, Santander, Cork and many more. The broader contextual framework was to imagine the city at a different scale, which led to a much larger global city of data interrogation which was to be called ‘ecumenopolis’ in later work (See Section 6).

In summary, by putting new systems in place that can re-employ our perception and thus create a new understanding of how this behaviour unfolds, the media artworks act as a *dataveillance*. Data-driven urbanism produces several activities that have profound social, political, ethical consequences as Rob Kitchen has argued (Kitchen, 2018).

The technical methods evolved in the course of the research took the form of mobile sensors, which were in turn taken to various locations, and setting up a network each time in situ to monitor the site or landscape.

4.1 House. Forces Of Invisible Agency (2007)

The private home the artist lived in is monitored to capture the invisible dynamic space, represented by data, and to interpret this space. The data is broadcast live and in real-

time online for six months so that the house itself was performing while being represented as a data network online. The artwork is still online, and a version was archived. House was made during the artists AHRC research fellowships at Goldsmiths College, University of London.

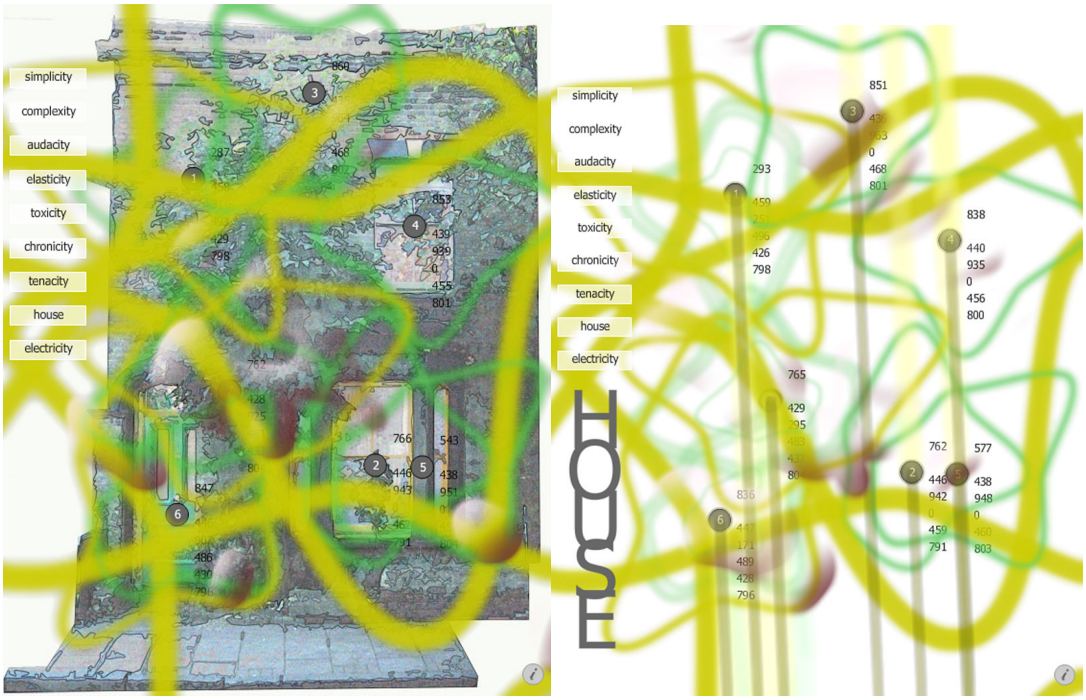

Figure 18: House. Screenshots of software system (Stanza, 2007)

4.2 Gallery. Invisible Agency and Cultural Behaviours (2008)

The installation used the artist's multi-nodal wireless mesh sensors to make the invisible visible and describe the actual art gallery; in this case, in the upper gallery in Plymouth Arts Centre, England where the exhibition was held. Commissioned by Helen Sloan of Scan and Paula Orrel from Plymouth Arts Centre, the artwork portrays the shifts in the data within gallery space reinterpreting the light, temperature and noises in the physical space over time. The virtual digital artwork becomes the real-time flow of

the things around us that allow our senses to invoke understanding.

The digital artwork is also by default responding to the audience, who are inside and therefore responding to the architecture. The gallery interior has been made virtual and placed online by monitoring micro-changes in the environment. The gallery becomes the artwork formed by the real-time data in space. This artwork used data to focus on what we cannot see as an imaginary poetic space posing a discrete set of research questions:- What happens to the gallery, and the agency of the visitor in the space?

Drawing on a tradition of creating apparently empty rooms as art, starting with Yves Klein (The Void, 1958), the gallery is essentially presented as an empty room, yet is also full of sensors with an online representation of the space itself. The intervention in the gallery and interactions in the space created by visitors changes the data, to create a virtual online avatar, and finally the whole experience becomes projected back inside the gallery. Thus experiences can also be witnessed online since the whole thing is parsed through the internet and also shown online.

The conceptual proposition is that the space is the artwork, and data are the medium used to form this real-time digital artwork. The artwork questions whether meaningful cultural interactions can take place by changing the way we focus on space and considering what new media art is in the process.

When out of the gallery, the building itself has behaviour, and so does the surrounding environment. On the smaller micro-level things continuously change in the gallery. The gallery itself is made alive by the objects that move inside and make noise, people, for example. This interaction is both a participatory and performative element in the gallery and it is embedded into the artwork by default. The sensors are controlling this. The gallery, even without visitors, is made interactive by this element of control.

Extending this further, ‘Gallery’ focuses on the body within a data space. The body affects the artwork by default as a responsive mediated experience; this implicit relation to the body is developed more coherently in the artwork ‘Body’ in the next

section. The body becomes both the interpreter of the artwork and the actor that affects, albeit on a micro-level, the data streams, noise, temperature, light. The anomalies of presence in this work are not crucial to any interactivity.

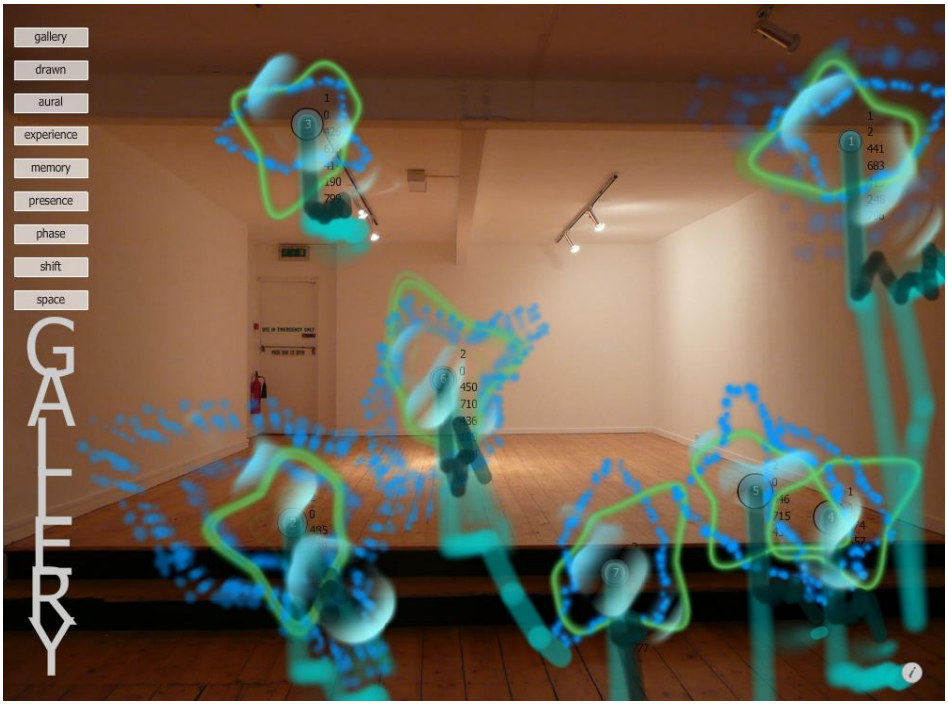

Figure 19: Gallery. Online interface inside Plymouth Arts Centre (Stanza, 2008)

4.3 The World Of New Possibilities (2010)

The project is in Volume 2 as a local version of the website. (See V2. WEBSITES 4.3)

This media artwork installation exhibited at Towneley Hall Park Burnley as part of AND festival[83] was commissioned by Folly.[84] The painterly squiggles on the image show a representation of the data, and the sounds you can hear (V2 4.3) are streams of data which the artist has turned into sound. This is made from multiple real-time wireless sensors that gather environmental data from the outside park bringing the outside data

[83] Abandon Normal Devices. https://www.andfestival.org.uk
[84] Folly set to close. https://www.bbc.co.uk/news/uk-england-lancashire-14492367. Accessed 18 Sept. 2017.

inside to explore interpretations of a real-time landscape, by creating an interactive space which is also online.

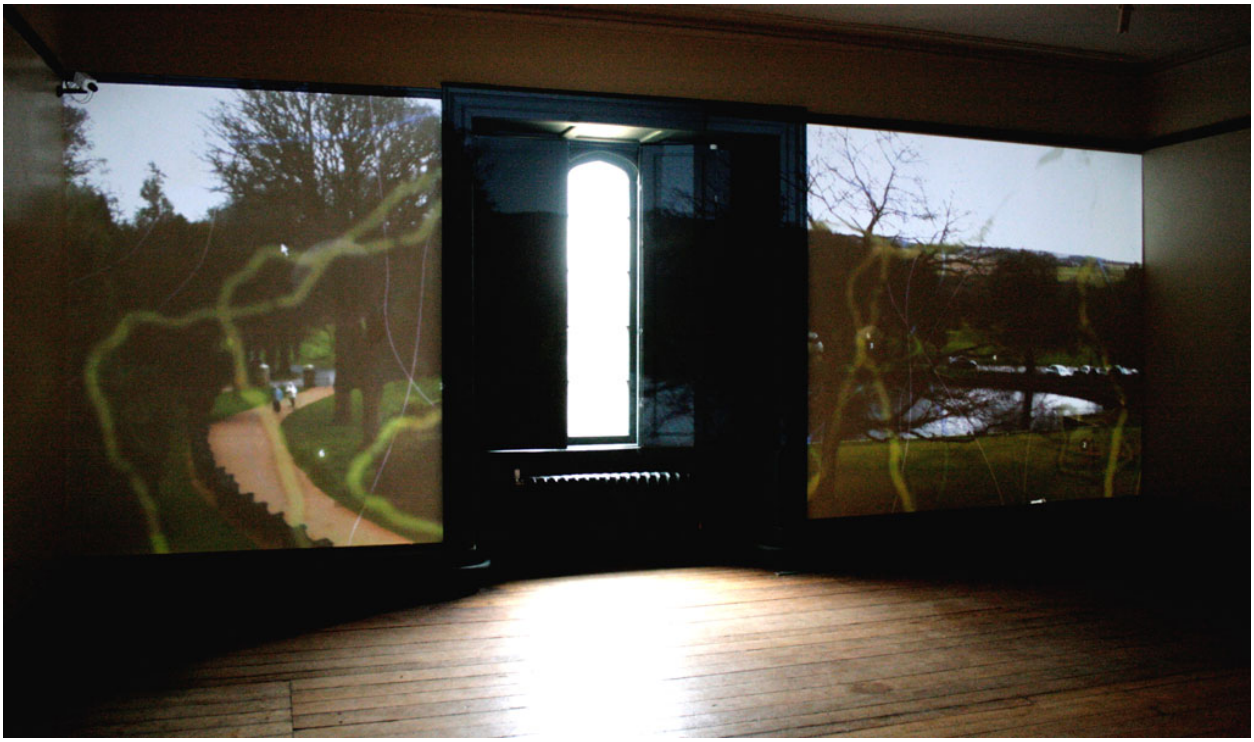

Figure 20: The World of New Possibilities at Towneley Hall Park (Stanza, 2010)

Figure 21: Stanza sitting in grass deploying sensors in a field in The Lake District (2010)

The visualisation of the outside park is projected right across the back wall of the main room, including over the closed window that had the same view. The output thus creates a data telepresence. It is however not the visual placement of one thing to the next, but a manifestation of viewing and experiencing a whole landscape under its sensory attributes, an attempt to create a poetic sublime by creating an additional layer of information about the real world.

4.4 Data Data Data. (2010)

The research aim of this project was to explore how arts interventions can make a significant contribution to creating a more people-friendly city centre,[85] through a fascination with data aesthetics in its purest form as information.

Figure 22: Data Data Data. Shown here are projected from FACT Liverpool (Stanza, 2010)

[85] Data Data Data (2010). Commissioned as part of The Golden Opportunity funding programme at FACT, Liverpool. See archived website https://www.stanza.co.uk/data/

By monitoring the city and projecting it back onto itself, the artwork facilitated a level of control within the manipulation of the real-time data stream that represented the city. This urban spectacle aimed to make the invisible, visible. Data Data Data became a live, real-time data visualisation of the connected city space in Liverpool. This artwork re-distributes information about the fabric of our cities by deploying the sensors and new technologies, re-engaging with the urban fabric thus enabling new artistic metaphors within city space.

The agency of the real-time city is what is networked and then remediated into the digital experience, which becomes visualised as an outside media art experience in public space. The datasets are in effect numbers turned into more numbers which represent the currency of observations that engage this dialectic between the real and virtual world.

4.5 Conclusions

These four new media artworks remediate data streams into different systems of real-time data that allow the audience to witness the demonstrated transparency and open dataveillance now embedded in the connected city.

These artworks suggest that we are all connected and that all actions influence the system by the very agency of the actors involved, which is from a global perspective, everyone. Everything we do can be sampled into technological systems to create new meaning, even when realised as abstracted squiggles or moving numbers presented as new media artworks online and in the public domain.

This *agency* becomes *the* essential motif in the artworks in the following sections. The body is by default always present in the data space. Furthermore, as such, the data

are both responsive and interactive.

Section 5. Media artworks demonstrating iterative development

Three more networked media artworks were made by creating novel interfaces for public engagement of environmental data-spaces. This series of media artworks builds on previous methods and research investigations referred to in the Sensity project. Sonicity (2010), Singing Trees (2013), Body (2014), also all use environmental data to extend the ways real-time data can become experienced.

Common methods with these artworks are that they process collected data into other forms; either into sounds as in Sonicity and The Singing Trees, or affecting custom made electrical systems by triggering LEDS as in Body. They all needed additional new tools and systems developed to interpret the data streams. They all treat data as a fluid medium to be changed and expressed into another form incorporating real-time events and experiences across distributed city-wide environments and systems.

These three art research projects all have in common the main questions of the thesis exploring real-time data resources representing city environments while focusing on issues concerning surveillance to create plastic, sculptural and visual forms.

5.1 Sonicity. Songs Of Atoms, Time And Space (2010)

This project is in V2 WEBSITES 5.1 and V2 EXAMPLES 5.1

Data as sound. Space as Sound. Gallery as Sound. City as Sound. World of Sound.

In the first of the projects critical to the development of my broader research questions, there was the potential to make the invisible data of the space audible, thereby disclosing at the same time a relationship to what we cannot see but which can be made real, in this case audible, as a sonification in real-time. To create these interactions required the development of custom software which supplies the audio heard by the audience.

Sonicity is presented as an art installation on the floor in art galleries as a sprawling mass of 170 speakers and all the connecting cables are laid out across the floor like a rhizomatic network which the audience can walk around. Sonicity was made over three developmental iterations, and initially developed and funded during an arts residency at Lanternhouse International, Ulverston in 2010. That year it was presented at Filmwinter Expanded Media in Stuttgart, Germany and was later exhibited at TSSK Trøndelag Centre for Contemporary Art, Metamorf Trondheim Norway (2014), where the sensors were placed all over the city of Trondheim for one month. It was expanded again when it was shown at La Panacée in France (2015). The project is now approximately 35 metres square.

Figure 23: Sonicity. Songs of Atoms, Time And Space. Installation at Ulverston International (Stanza, 2010).

Methods

This digital media installation was created using similar methods of practice to Sensity for gathering data. However Sonicity focuses on the malleability of the data stream and how it can be remade and expressed into other forms. The context was shifted by implying that the data flow has agency and is performative, and in this case it is turned into sound. The sounds created are a reflection of the flow of the invisible in the data space, the agency of the data and this is represented as an ambient sonification. You experience an acoustic responsive environment, literally the sound of the micro incidents of change that occur over time.

The method was extended to support user interaction with the data and the audience by creating a series of software based mixing desks that allowed the incoming data to be mixed by the audience in the gallery, thus handing over control of the mechanism of both the invisible and also control of the actual (the data). The interface includes atonal note customisation with a harmonic variation for the whole system. It features mixing consoles for each independent environmental data set, all working in real-time. In summary, light, temperature, sound, noise, pollution, location, pressure, are all turned

into sound from across a sizable monitored environment. In 2014 at the Metamorf exhibition in Trondheim Norway, these sensors were placed down the street and in the city so that the sound stream represented the live agency of the whole city.

The project extends the research questions by investigating how an audience experiences data, where that is all around us and in which we are all active agents? This aligned with demonstrating the activity of invisible events that facilitate this and which is experienced as sound.

This artwork futher supports the investigation by using the technologies deployed to imply another meaning, in this case a musical sound stream, while still operating within the themes of the surveillance culture, privacy and the connected spaces.

5.2. The Singing Trees (2008 - 2013)

The Singing Trees installation became a further sonification of the real space and environment. This artwork was first made as part of the author's AHRC fellowship at Goldsmiths College and the prototype set up in Hyde Park (2008). Further development occurred for the Confluence art programme at the Tremough Campus in association with Falmouth University and the University of Exeter (2013).

The challenge in the work addressed how newly created data-spaces help us understand and experience the outside environment in different ways, demonstrating how public space can be affected by a sonic experience, in this case a singing tree which represents the sonified space.

Research Methods and Newly Developed Technology

The installation used similar methods to Sonicity above; however to explore the technical work further sensors are hidden all over a tree in a public park thus extending the experience of the artwork by broadcasting sensor data (light, temperature, humidity, noise, and GPS location). Here the data are translated into music using custom made software, and the results produce a networked singing tree which can be heard in the park by the public. Additional technological methods developed included a custom made speaker system for the audience to hear, and solar power systems so that it could be housed remotely outside.

The artwork can be interpreted as a performative sculpture, in this case in a tree that creates new sonic experiences in real time. The sounds heard are the sounds of the changing environment, the sound of the stuff that is all around us that is turned into a real-time sound stream using methods previously devised, i.e. dozens of wireless sensors. In other artworks, the data came from outside to inside. Now it is also fed back out again, creating a feedback loop, pushing further the understanding that data can be formed, shaped, altered, and its context and value shifted.

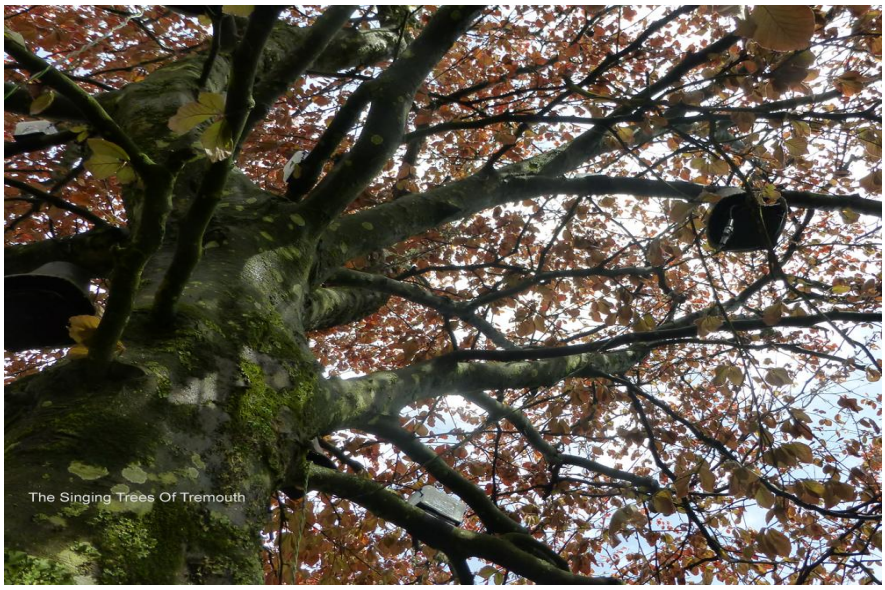

Figure 24: The Singing Trees. Tremough Campus University of Falmouth. Followed on from Version one in (2008)

with solar panels (Stanza, 2013)

5.3 Body 01000010011011110110010001111001 (2012)

Commissioned for the Open Data Institute (ODI) and exhibited as part of the 'Data as Culture' ***Body*** was also exhibited in TSSK (Trøndelag Centre for Contemporary Art). Trondheim Norway (2014). Body was later displayed in the Bruges Museum, Belgium (2015) as part of the author's solo show titled ’The Intelligent City’.

Real-time environmental data becomes embodied in this life-size sculpture assembled from custom made computer components and acrylic slices of the artist's real physique.

The figurative sculpture, which is a representation of the artist, responds to the emergent properties of environmental data in South London, where the artist's wireless sensor network is situated. 'Body' is 2.24 metres tall, and it is a free-standing structure developed for the commission from a series of sketches. It is made of hundreds of LEDs, motors, wires and custom made electronics all responding to changes in the data, i.e. temperature, light, pressure, noise, and the sound of the city. The artwork becomes a manipulation of data, that 'powers' all the 'events', 'actions' and 'processes' that you see in the sculpture.

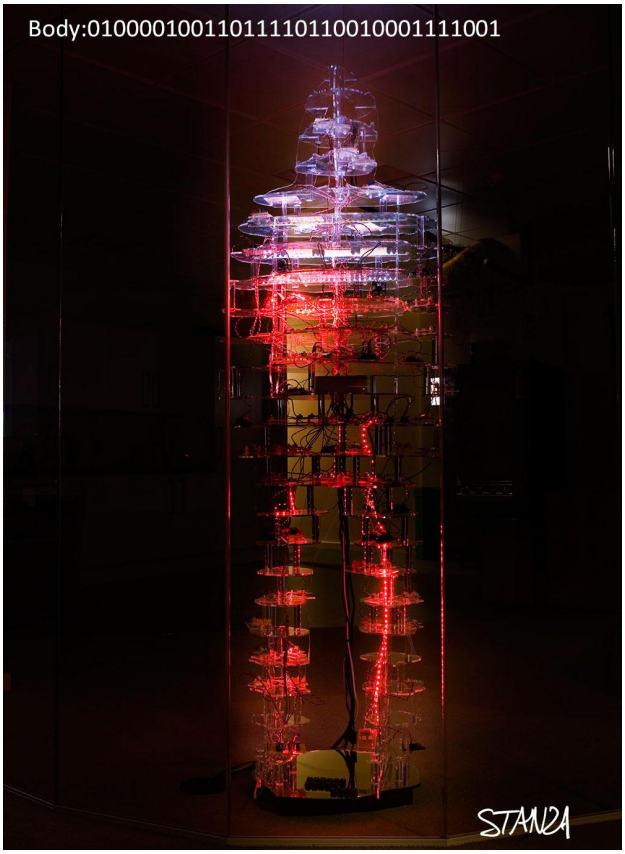

Figure 25: Body. Installed at the Open Data Institute, London (Stanza, 2012)

Custom made software is once again used to gather data from the artist's sensor network via the custom-made java proxy server, and sends it to the sculpture. The mote reader software sends events to the sculpture.

The research aim is to represent the changing life and complexity of urban space and to output this as a dynamic, kinetic sculpture, demonstrating that a fluid data space can be made more open, addressable, structured, accountable, and continuous. Because the data is networked other online users can also reinterpret the data and interrogate the various sensors in the network.

The body itself raises further questions of embedded data and the allusion that the body itself will become a networked device of retrievable data at some point in the future. The sculpture aims to go beyond simple single user interaction to monitor and

survey in real-time the whole city. It entirely represents the complexities of the real-time city as a shifting morphing and complex system; the body is witness to this.

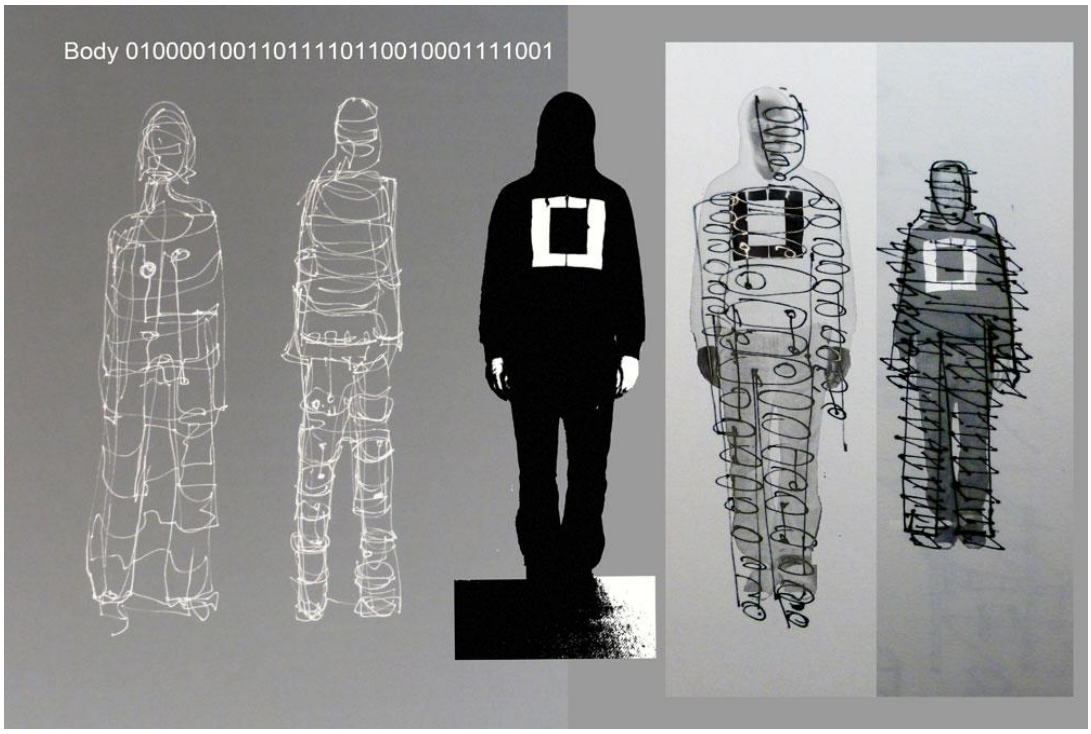

Figure 26: Sketch for Body (Stanza, 2012)

Data have become more accessible to artists, and have been opened up for use as a raw material. We now see more data integration into artworks that explore environmental, socio-political and economic aspects of society.[86] This sculpture pulls data out of the virtual domain and into our physical world. The artwork provokes discussion around the concept of open data, how it informs and affects us, and how we interpret it to have meaning.

In summary this sculpture is speculating on situations where embedded technology inside our bodies is having a conversation through other information networks, i.e. the body is seamlessly connected to a wider information network. The data body has

[86] Julie Freeman curated the show at the Open Data Institute (ODI). It was the questions posed by the curator that supported the context. "Who wrote the algorithm? Who wrote the code? What are the unexpected consequences of combining different data?"https://theodi.org/data-as-culture-2012

become infobese with new additional information that streams through the networks.[87]

5.4 Conclusion

Through iterative practice the purpose of these three artworks was to explore how, in a different setting and different display contexts, the meaning and experience can be altered creating new aesthetic experiences of our cities' environments that result from combining datastreams from multiple online cities.

This section demonstrated various outputs using the methods devised but more importantly it led into the next significant artwork which switched back into investigation of systems of surveillance control.

Section 6

The Nemesis Machine – From Metropolis to Megalopolis to Ecumenopolis (2010 -

[87] From the essay Data, People, Art; “When installing the work, the artist was very clear that there was not a representational connection between the data and behavior of the LEDs. This is a deliberate rebuttal of the tendency for both arts and technology, and art and science projects to be viewed as useful services to technology or science in the form of lovely, educational, yet very literal representations of data.” Graham concludes, "Body, therefore, stands at a significant crossroads of science and art, and at the contested boundary between technology and the body. This borderland, which has in the past been primarily mapped in terms of gender, including by artists such as Lynn Hershmann, but is here, instead, explored in terms of class. It is therefore good to see Stanza's Body seeking not to control the sublime mass of data 'out there' but to use a much more domestic, human scale, a non-literal mapping of sensor information, and a critical view of open data.” (Graham, 2014)

2019)

The project is in Volume 2 as a local version of the website. (See V2 WEBSITES' 6.0 and V2 EXAMPLES 6.0)

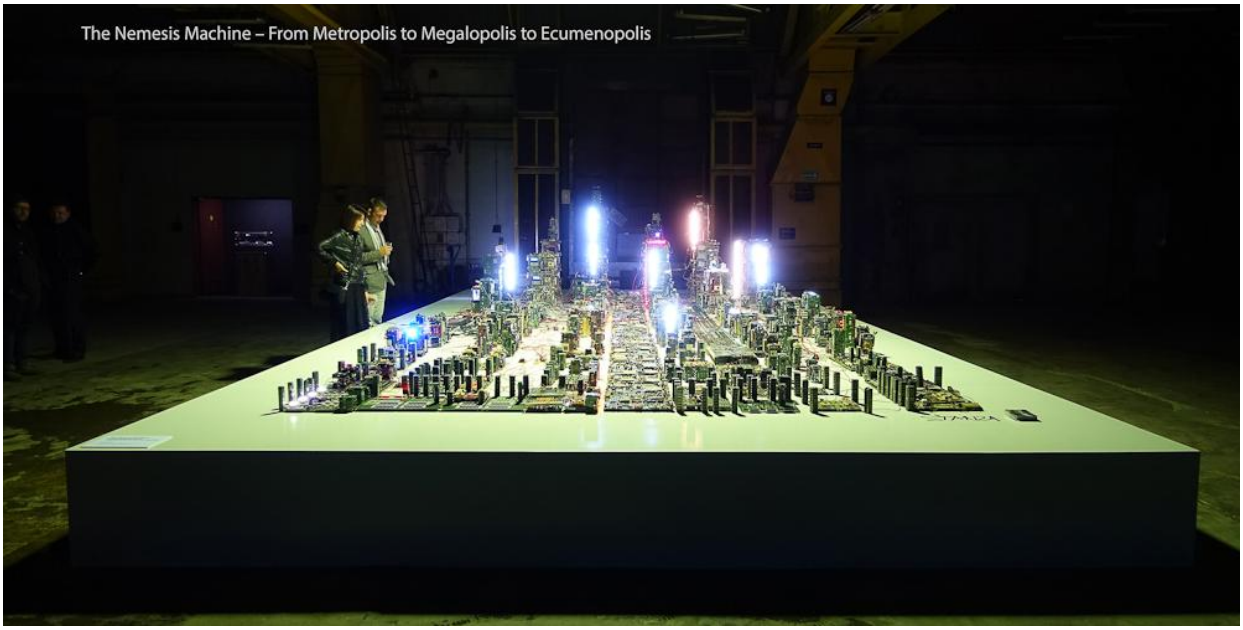

Figure 27: The Nemesis Machine in Warsaw Poland at Beyond The Seven (Stanza, 2017)

> *'if aerial photography showed us the muscular and skeletal structure of the city, the revolution in urban informatics is likely to reveal its circulatory and nervous systems. I like to call this vision a real-time city because for the first time we see cities as a whole the way biologists see a cell' (Townsend, 2015).* [88]

Introduction

[88] Handbook of Research on Urban Informatics: The Practice and Promise of the Real-time City (Marcus Foth 2008 the quote is from P XXVI By Anthony Townsend. More recently, Townsend notes that this line of thought has given rise to at least a dozen new academic labs, departments and schools that explore this new understanding of the city (Townsend 2015). https://martijndewaal.nl/?p=1589

Through artistic process and continual development, ***The Nemesis Machine*** evolved over a seven-year period from (2010) and is still ongoing.[89] During this period this art project has had funding and support from Lanternhouse International and received an award, Digital Turku Grand Prize Finland (2011), as well as first prize in Share IT Italy.

Clearly indicating the work's cultural significance and cutting edge influence it has been exhibited over twenty times at various international venues[90] and during this development many curators helped facilitate and support the curatorial development at these venues including:- Andrea Hawkins, Irini Papadimitriou, Emmanuel Cuisinier, Sarah Cook, Till-Holger Borchert, Ine Gevers, Ghislaine Boddington, Marco Mancuso, Piotr Krajewski, David Drake, Lucy Johnston, Christiane Paul, Richard Rinehart; there were also numerous press articles, catalogues, and radio interviews.

The interdisciplinary nature of this artwork resonates both as a media art installation but also as a prototype demonstrator investigation into smart cities using mesh sensors for environmental monitoring. The groundwork for the technical data platform had already been developed for the other projects (See section 3.1).

What follows became a period of making or practice as physical objects were developed that were needed to allow the audience a physical experience of the work that just a visualisation could not achieve. In Sensity (Section 3.1) the work had been in effect making software systems, and the code became the material to make all the visualisations to date. Over the next seven years (2010 - 2017) through various iterations, a series of organic modular and scalable interconnected sculptural objects were made using physical structures; the title also changed several times from

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[89] In 2010 the artist was participating in an arts residency at Lanternhouse International in Ulverston (now closed down).The director Andrea Hawkins asked Stanza directly what they could do to move the research forward and provided some funding. The artist proposed a physical sculptural representation of concepts and ideas from the AHRC fellowship addressed in sections 1 and 2 above.

[90] Exhibitions list. Lanternhouse International UK (2010) . Gogbot Festival Enschede Holland (2011). New Technological Art Award Ghent. Belgium (2012). Share Festival Torino Italy (2012). Watermans Gallery Brentford. London (2013). TSSK Trøndelag Centre for Contemporary Art Trondheim , Norway (2014). Centre des Arts d'Enghien-Les-Bains Paris, France (2014). The Intelligent City Arentshuis Bruges Museum (2015). Hacking Habitat Art of Control Utrecht Netherlands (2016). Dundee Contemporary Arts at Centrespace NEoN. Dundee (2016). The Internet of Things World Forum Tobacco Dock, London (2017). WRO Art Centre Wroclaw Poland (2017). York Art Gallery UK (2017). Beyond The Warsaw Poland (2017) . Future Festival Nesta UK London (2018). Measures Of Life Lumen UK Hull (2018). Speculum Artrium Decades Trbovlje Slovenia (2018). Cynetart Dresden Germany (2018). FfotoGallery Diffusion Cardiff, Wales (2019). DAS CUBO Bologna, Italy (2019) .FOS Festival of Speed Goodwood ,UK (2019).

Capacities[91] to The Emergent City[92] to The Nemesis Machine.[93] The artwork grew and developed much like a real city. With each iteration, it changed venues, it changed scale, and it represented different spaces. Each version also had a separate website with supporting documentation.

Since the first build in 2010, other newer terms have emerged that are now used as labels to describe the city and its urban technological condition. These labels included interactive cities, smart cities, intelligent cities; as such, this artwork also operates across these other fields of inquiry and can be seen as inter and cross-disciplinary. All these terms can now be applied to The Nemesis Machine as well as to the interdisciplinary space the artwork operates and is situated within.

Figure 28: The Nemesis Machine in Dresden, Germany (Stanza, 2017)

6.1 Aims

[91] Capacities: Life In The Emergent City (2010). Project archieve http://stanza.co.uk/capacities/index.html
[92] The Emergent City. A Life From Complexity to The City of Bits. (2013) Project archive http://stanza.co.uk/emergentcity_show/index.html
[93] The Nemesis Machine – From Metropolis to Megalopolis to Ecumenopolis (2015-17) Project archive http://stanza.co.uk/nemesis-machineweb/index.html

The underlying premise in this artwork was to create rich artistic metaphors to understand the real-time city and the environment in terms of data collection as a canvas for artistic creativity and inquiry. At the centre of the research and the artistic investigation lies a multi-layered expression of technology-based futures concerning big data, privacy, liquid surveillance and control.

Through iterative practice this artwork adds explorations and insights to the previous investigative process considering how we consciously or unconsciously influence each other within the broader algorithmically controlled system, the city, and to the degree to which technology may in future take over control of our bodies and our presence in the city.

The challenge in the work was to demonstrate how a media artwork illuminates our relationship to the real-time city as a living system in terms of understanding how data is made malleable from the real world to the virtual world and back to the real world in the installation.

Creating this new media artwork facilitated further the conversation about the real-time city-wide flow of data in the sphere now called liquid surveillance (Bauman, Lyon 2013) and surveillance capitalism (Zuboff, 2018)[94] and it is timely and important to evaluate this artwork within these contexts which have now become established in scholarly research.

The construction, that is the sculptural installation, was developed to reflect changes in our relationship with the digitised world, new technology, and our algorithmic society. This deliberately focuses the attention on surveillance, and networked space; and embeds panoptic aesthetic manipulations via data from the multi sensor networks as well as real-time feeds from CCTV cameras.

6.2 Technical Methods employed to make the artwork

[94] In (2015) the artwork was described by the artist online; "to operate within the themes of the urban landscape, surveillance culture, privacy and the connected city and pose the question of who owns the data while speculating that virtual borders will soon create more systems of control. By visualising the space all around us as 'worlds' full of data across the internet, the artwork also acts as a smart city; a hybrid internet of things (IoT) installation. 'The Nemesis Machine.' http://stanza.co.uk/Nemesis_deus/index.html. Accessed 22 Oct. 2017.

The installation has been developing for seven years with constant new technological production and development. The exhibition logistics also changed from a six box installation to an extensive sixty box hybrid art system that takes two hundred staff-hours to set up and take down, and can be more than 100 square metres in size.

What all the installation versions have in common through the iterations are the data collection methods, the concept, and the artistic objectives. It is at all times responsive to the live real-time environment via sensors and interactive with its embedded surveillance systems. The artwork discloses how data is manipulated that is powering all the 'events', 'actions' and 'processes' in the installation that unfold in the real world and through online networks.[95]

The data collection technology is based on the artist's own development of a wireless mutli sensor network which is laid out across the city. The system monitors temperature, light, pressure, GPS, and the sound of the city. On the floor, there are hundreds of electronic components including fans, LEDs, solenoids, and motors. The fans turn when the temperature changes, motors turn when the light changes, and LEDs light up when sound sensors become activated in the city. The installation is, therefore, responding to the wireless sensor network deployed in the gallery and across the city.

The artwork also incorporates another system that 'powers' other 'events', 'actions' and 'processes' in the installation. For example a NO2 module nitrogen dioxide analyser is used to detect pollutants in the air. There is a CO2 carbon dioxide sensor for the measurement of carbon dioxide gas in monitoring indoor air quality and an O2 sensor that measures the proportion of oxygen in the air. There is also another local temperature sensor and light sensor. An alcohol sensor can tell if anyone had been drinking and relative changes in the display system are affected accordingly if any

[95] Charlie Gere, the art historian, in the essay Object-Oriented Aesthetics describes the Watermans exhibition: 'The spectacle is deliberately made to be compelling to create what might at first look like a model of a city and exhibits some kind of autonomous activity that seems more than merely automatic' (Gere, 2013). Description of work from 2010 by Stanza docemented here. http://stanza.co.uk/capacities/index.html

change in the alcohol concentration in the atmosphere is detected.

In conjunction with this, eight custom made surveillance cameras with computer vision capabilities and facial tracking place the audience inside another monitored system which is also embedded in the artwork via a series of miniature screens.

6.3 Conclusions and Reflections on The Nemesis Machine

The city has become a performance space, a theatre of observational flow. It was implicit in The Nemesis Machine that the whole data space was being monitored and by default the bodily activity within this space is also embedded. The aim of the installation was to go beyond simple single user interaction to monitor in real-time the whole city.

The observed audience can no longer be considered hidden inside the crowd where we can be spotted and tracked. The Nemesis Machine mirrors the real world with micro-cameras tracking the audiences every action enforcing the panoptic objective. The artwork like the city is embedded with these conflicting issues of privacy and control.

At the same time, using the methods deployed, this information and data are reformed creating parallel realities which enable the visitor to be present and experience another space. The intention is not to impart knowledge directly but to present experience in a way to dramatise these conditions which are operating on a scale outside human perception.

The installation represents the real-time city as a complex morphing networked system. The idea was to think of it as a system on a global scale with its legions of sensors and algorithms all becoming an interconnected networked technological system with layers and layers of twisted entangled and hidden meaning.

Figure 29: The Emergent City. Future Lab Goodwood Festival (Stanza, 2019)

The artwork experienced is a city of electronic components and data processing that reflect in real-time what is happening elsewhere, creating a panoptic aesthetic experience. The panoptic impression that is implicit in the research becomes reinforced when the audience sees the small screens which show real-time pictures of the visitors so that they also become part of the artwork. The artwork becomes an immersive spectacle, and the audience are complicit in relationship to any data in the bigger system; the audience are now active ingredients in the flow and temporality of the artwork.

The Nemesis Machine operates to display many data layers showing the data from the algorithms and their manipulations inside the installation, but this only serves to double down the suggestion that tactical approaches of transparency or sabotage are futile, because the overall impression is of a battle lost to the dystopian. This is witnessed in the Orwellian themes of surveillance which are embedded in the lens-based mass observation platforms we see today.

The artwork is also situated in the middle of broader concepts for smart cities, and the

new technologies that monitor the real-time environment. The data and their interactions, that is, the events occurring in the environment that surrounds the installation are translated into the force that brings the electronic city to life. Essentially this process is causing movement and change that then create new events and actions to occur.

In this way the city performs itself, in real-time, through its physical avatar or electronic double. The city we see performs itself through an-other city (the artwork). This seamless integration of place and data processing technologies forms a composite totality of cooperation, co-dependence and global reach.

This artwork raises further questions on whether technology may in future take over control of bodies and presence in the city. The sensor city can infringe upon citizens' privacy, and it can profile and socially sort people and enact forms of anticipatory governance, and control. This suggestion indicates the broader implication that smart city technology is eroding our rights and diluting democracy.

The city is presented as a system in this way to suggest that there is no privacy in the broader city any more, since all these new technologies interact to monitor everything.

The title 'From Metropolis to Megalopolis to Ecumenopolis' expresses this growth from a small city metropolis to a large city megalopolis, to the ecumenopolis, which is a term for the whole world as a city. The inference is that this system of technology is all-encompassing, all seeing and all powerful and on a planetary scale.

The title ‘Nemesis’ also suggests and refers the audience to a portrayal of either utopian or dystopian futures inferring 'the inescapable agent of someone's or something's downfall'.[96] As such the Nemesis itself is positioned to cause concern as a situation or event, causing serious harm, or even as a form of punishment. The word Nemesis originally meant the distributor of fortune, neither good nor bad, simply in due

[96] Definition of Nemesis https://www.merriam-webster.com/dictionary/nemesis. [Accessed 14 Oct. 2019]

proportion to each according to what was deserved. Nemesis was sometimes called 'Adrasteia', probably meaning 'one from whom there is no escape'. This is how the artwork positions itself as neither one or the other, but to engage the viewer or the audience inside this inescapable agency.

It is important to stress that in terms of hacking cultures and the manipulation of the data streams the research becomes a visual polemic. It intends to create a didactic or activist position, allowing the tension in the artwork to resonate with the audience. It is the audience whose very agency affects the result and whose agency will be needed to change or break the critical flows of this data. This agonistic exchange seeks to create further anxiety for the audience.

Figure 30: The Emergent City exhibited at the Future Lab at the Goodwood Festival Of Speed (Stanza, 2019)

The city machine has therefore become alive and of itself. This parsing of real-time data systems becomes a critique of liquid surveillance networks in that a whole city can be seen all at once from a variety of perspective lenses. The machine is both acting to liberate us through technology with overtures to open processes, while at the same

time making us complicit in its restrictive rule of control. We have, by default, become complicit in the global surveillance machine that appropriates us the users by our agency as units of data to be harvested for some gain (either financial, or social). This notion has been a consuming theme in all of these artworks since 2007 and cannot be separated from the author's practice.

The Nemesis Machine also focuses on the aspect of the smart city as a space for the parsing of (any /all) data in relation to these thoughts. There are now numerous players from state to corporate bodies that create all types of open data access like the ones developed for these artworks that lead one to speculate that indeed the age of privacy is over.[97] The final question posed by the installation might therefore be: Is this a utopian vision or dystopian vision of our future world that is being facilitated through these technologies?[98]

In appearance The Nemesis Machine is like Big Brother parsed through the lens of the Internet of Things, a stacked technological machine of observation. The Nemesis Machine appears to create a vision of a bleak future if warnings are not heeded, whereas Visitors to A Gallery demonstrated a complicit relation to the powers that watch and control, and The Global Dérive (2017) sought to give power back to the collective to re-energise agency and collaborative practice by sharing the data and the values embedded within.

[97] The future of privacy. https://www.pewinternet.org/2014/12/18/future-of-privacy/ [Accessed 4 Oct. 2019]

[98] New artworks by the artist which are not included in this thesis but have become part of an ongoing inquiry into more comprehensive systems that include phone and WIFI tracking systems. These works are being funded by a STARTS residency which can all be used to generate geospatial data and large groups of data objects in the real-time city investigating these questions using a different technological lens.

Section 7 Conclusion

> *'Art at its most significant is a distant early warning system that can always be relied on to tell the old culture what is beginning to happen to it' (Marshall McLuhan, 1964[99]).*

Since this thesis is based on practice-led research some arguments are now presented as to how new knowledge has been created in relation to the body of artwork, the inquiry (including the methodology used), and the research questions.

The research questions are:

1. What possibilities do real-time data resources representing city environments offer artists?

2. How might artworks enable us to reflect critically upon issues concerning surveillance?

3. What plastic, sculptural and visual forms might data-oriented digital artworks take?

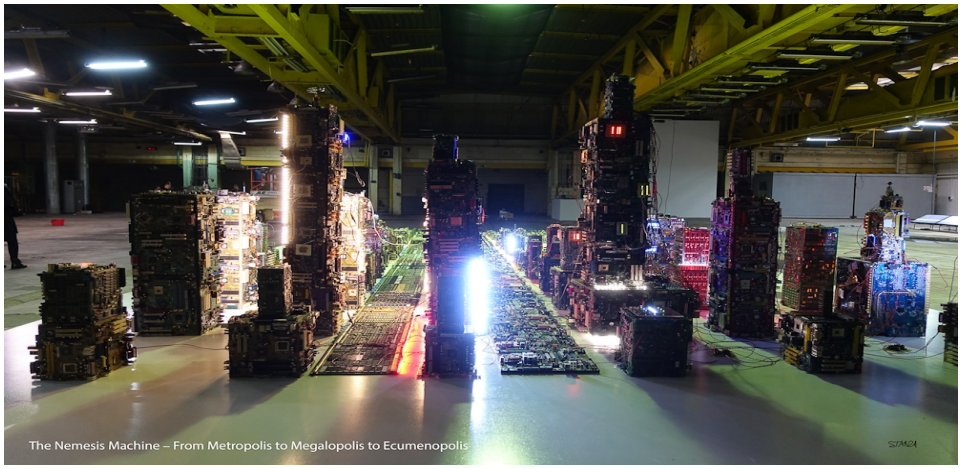

Figure 31: The Nemesis Machine exhibited at the Beyond The Seven, Warsaw. Poland (Stanza, 2017)

[99] Marshall McLuhan, in Understanding Media (1964) “I think of art, at its most significant, as a DEW line, a Distant Early Warning system that can always be relied on to tell the old culture what is begin-ning to happen to it.” reference https://gsalibrarytreasures.wordpress.com/2013/10/16/marshall-mcluhans-dew-line-newsletter/

1. The possibilities for artists

At the start of the programme of work, the aim was to investigate the monitored landscape and frame this inquiry within art by creating a modular technological framework that would lead to the creation of several artistic outputs. In evidencing the multidisciplinary nature of these artworks, we see that they are now also cited in the developing field ‘The Internet Of Things’ (IoT), and in global smart-cities schemes, as well as in the field of new media art. Implicit also in this research and other IoT platforms[100] are multiple layers of convergence that will inform the future city. This was expressed most succinctly in the work The Nemesis Machine, which was a possibility not foreseen at the start of the research.

Furthermore one of the objectives within this arts practice and research was to question the broader social implications of opening up real-time networks, by asking who owns this space. A secondary problem discloses itself which cannot be separated from the inquiry and the published outputs. What are the ethical implications of real-time information systems for artworks? Since by default the author is aware of the contradictory methods of control and ownership inside the networks his position, therefore, can only be to find new language, in this case exemplified through the artworks. Stanza owns and has developed these networks as test beds to facilitate the work but notes that the control of the networks is therefore by an individual despite the aims of common ownership. Thus rests an uneasy tension when posing ethical questions about ownership and control.

The publications in summary allude to possible future dystopian perspectives but make these connections in subtle non didactic embraces. The artist Lisa Jevbratt, working at the forefront of new media art, indicates: 'What she or he finds is not an absolute but a maybe, made of hints, suggestions and openings' (Corby, 2006, p.95). This poetic rendering of the networked real-time object is thus only a hint, a gaze within a gaze,

[100] City dashboards include many world cities Barcelona, Manchester, Los Angeles. The Dublin Dashboard provides real-time information, time-series indicator data and interactive maps about aspects of the city for example. However, not many have open data feeds via their APIS for accessing real time data and I couldn't find any with environmental sensors.

looking within as it happens as opposed to looking back.

As sociologist Saskia Sassen has argued: '[t]he digital is embedded in the larger … systems within which we exist and operate …. Through this embeddedness, the digital can act back on the social so that its specific capabilities can engender new concepts of the social and of the possible' (Sassen, 2006, p.344). The digital environment that is the virtual and augmented city is therefore social. Hence this virtual layer space that the data presents is a new environment for artists and artistic practice. The artworks are created by instruments of change that place them in this particular moment, addressing in visual terms the present time in which we find ourselves. It is easy to misidentify these works to solely be about surveillance or data; however they exist primarily as art and thus offer new possibilities for artists.

2 Reflections upon issues concerning surveillance and privacy

Implicit in the contextual review and the resulting outputs is the supposition that these artworks can be situated in universal panoptic surveillance as real-time performative systems that have evolved through practice over this ten year period, while addressing the initial research questions.

It can be argued that we not only become observed by the machine but are now governed by the machine. The Nemesis Machine acts to reflect the perspective of the city running the city, a machine running the city, creating a whole series of other more political questions about informatics that could be addressed through further work. The smartness in The Nemesis Machine lies in its ability to practise being itself. The code remediates the city, and the city remediates the code.

In the essay '*A City Is Not A Galaxy'* Martin de Waal, 2017 states that 'computers have become part of the city embedded into its very fabric'. Indeed, it might be better once again to think that the city is the computer, processing time-based events. The Nemesis Machine is a city computer system observing itself and observing the other

city. It is a self-reflexive panoptic smart city governed and controlled by algorithms.

The author asserts that the city is itself an art system. The Nemesis Machine simply acts to facilitate a series of multi-layered responses into the emergent growing city and a new understanding of networks and flows. In effect, it is no longer a system of place but a system of time (Batty, 2012). Furthermore, since this system will start analysing existing algorithms, the project is creating a machine learning intelligence which is directed back upon itself. It not only illustrates the ‘stack’ as Bratton refers to it; it is The Stack (Bratton, 2016).

These technological devices can be used to interpret the city, to dislocate poetically the performative agency of the data as a series of controlled and monitored events which also create a tension or conflict concerning surveillance and privacy.

Furthermore by asking what part we play within this system as the data is circulated The Nemesis Machine (the artwork) thus becomes a telematic machine interface to the city, which is what Castells refers to as rhythms and shared experience (Castells, 2000).The Nemesis Machine creates an interface to understand and witness, to monitor these flows operating at the centre of the new system, further enabling this panoptic reflection.

Inside the generative organic form that is the city, we need interfaces to parse the data, but what good will they be when they are parsed by a new algorithm that's continually and simultaneously shapeshifting between the utopian and dystopian. Will it serve or keep us servile? This question puts in place current works that are completely facilitated by the agency of their algorithmic systems.

The Nemesis Machine (the interface to the system) becomes lucid in the space and time it occupies as an interpreter of the global data sphere of the allusory and anxious presence around dataveillance, geosurveillance and anticipatory governance. It anticipates a world of omnipotent surveyed governance where the person in the city is not only aware of the situation but has become complicit in it.

This is an assertion current observers of the digital city are aware of, 'as such cities are becoming knowable and controllable in new dynamic ways, responsive to the data generated about them' (Kitchen, 2015 p.44). This suggests further control issues that are used to manage and control cities. We are at the start of a new big data era, and the flow and variety of urban data are only going to grow and diversify. As such, there are numerous competing corporate technologies which seek to merge all this into one funnel:- Cisco City API, IBM Smarter City, Microsoft CityNext, PlanIT Urban operating systems, which demonstrate that open-source data will be 'governed' by corporate interpretation. Urban big data is never neutral, but situated, relational and framed, and used contextually to achieve specific aims. Data-driven urbanism is political, seeking to produce a certain kind of city.

In creating an artwork as a system of systems The Nemesis Machine and Sensity and all the other artworks embrace head first the issue of data and ownership, namely that all these data are a valuable commodity. Therein lies the conundrum that The Nemesis Machine alludes to ....who will own this data and who will profit? Thus The Nemesis Machine becomes a political artwork whose leitmotif is ownership rights in the virtual world. Central to this is the further question: is this ethical? These telematic artworks themselves cannot escape the panoptic embrace.

As Geert Lovink and Patricia de Vries observe in the exhibition catalogue *'Please Come Back'*, surveillance has become DIY practice, based on the 'trope that the social world can ultimately be known, steered, and predicted from a value-neutral, unmediated perspective' (Lovink, de Vries, 2016). By design we have created a ship of fools since we are all in this boat together, complicit at all times in feedback to the surveillance system. A further problem is encountered because these data patterns are predetermined by the people who program them and the systems we interrogate for meaning. These systems are now so large that it is now impossible to mediate them, as by doing so they form into even more complex patterns so that there is a false sense of objectivity. A huge amount of analysis and storage are now needed just to keep up.

The endeavour to reflect the complex issues at hand and the problems identified might appear utterly meaningless. However they are nonetheless given meaning by this very lens of awareness and are reorientated through the perspective of an analytical framework seen in the author's artworks. The meaning, therefore, becomes one of dialectic and new discourses demonstrating how the more prominent machine is optimistically in need of serious repair, or pessimistically entirely beyond repair.

Artworks that used lens-based and data monitoring techniques sought to place the self and the body at the centre of a perspective of collaborative space and landscape. This fuels the despair of the monetized, observed self as data, which is stripped bare by the self-serving political economy. The relevance of the patterns inside these systems serves to demonstrate connections and relations thus casting light on the possibilities for change, by making known what was previously unknown. These changes could oscillate outside the realm of the state or corporate purview and somehow be more entangled within a collective embodied intelligence. This was a theme explored in the data city The Nemesis Machine (2010 - 2017) and more recently in the software artworks Dérive (2017) and Velocity (2019).[101] In these examples, phone based software APPs take data from users' phones and recombine them into a collective collaborative data visualisation, where all the users are actively tracked ingredients in the final soup, the artwork. As artworks designed for information legibility, it could be argued that ‘they are not neutral, embedded within them are the cultural and political dilemmas that facilitate critique and resistance’ (Terranova, 2004).

These technologies cannot be limited just to the practicalities of how things work as we are entangled with them. What is needed, therefore, is not new technology but verisimilitudes that challenge the limits of language through forms which are active, dynamic, and temporal. The artworks are formed in this space to create a

[101] Both are new works falling outside of this PhD. Velocity focuses on the idea that we are greater than the sum of our individual parts and by working together we become active agents for positive change. The focus of the artwork is participation and inclusivity within the larger system, rather than alienation and exclusivity which is caused by technology. The visualisation created is an alternative perspective based on human machine interactions that are structured through codified behaviors inferring collective agency. Project website http://velocity.stanza.co.uk/

'metalanguage' for describing the world that complex systems have wrought.

Today everything has been laid bare and open in cloud computing systems, business documents, credit ratings, health records, bank records, email and photos (Bridle, 2018); the connections inside these systems are endless, disclosing not only new knowledge but the experience of others and the wider world. This creates an argument for more thoughtful engagement with technology in this art practice. The artistic systems are full of noise and interference and data, and seek to collapse time and space, provoking displacement and agency.

As Edward Snowden wrote in his email to Laura Poitras, 'Know every border that you cross, every purchase you make, every cell you dial, every cell phone tower you pass, friend you keep, article you write, site you visit, subject line you type, and packet you route is in the hands of a system whose reach is unlimited but whose safeguard is not'. These are the emails Snowden sent to introduce his NSA leaks (Greenberg, 2014). It comes as no surprise that what was unsuspected but just not evidenced back in the public domain sounds remarkably similar to the author's earlier remark.[102]

3 Addressing question three through the plastic, sculptural and visual forms

The creative practice undertaken in Sensity as data visualisation through to The Nemesis Machine as a large scale installation demonstrated how the system of big data across networks can be utilised by the artist and incorporated into artworks and visual forms.

The audience becomes an active agent in revealing the hidden structures that give the maps and artworks their form through the agency of the real-time city that is made real by the representation of the data. These works therefore all articulate relevant artistic

[102] Referred to earlier.. 'Imagine walking out the door, and knowing every single action, movement, sound, micro movement, pulse, and thread of information is being tracked, monitored, stored, analyzed, interpreted and logged and we are complicitlyy involved' (Stanza, 2004)

and theoretical contexts to surveillance and new cultural mapping but they fundamentally also create a novel space for 'thinking through and with art' (Borgdorff, 2011). The new insights came into fruition by the very act of doing and practice, and its dissemination into the artefacts demonstrated and broadened the scope of networked real time data as a form of digital art. The data and the technology facilitated this new possibility of making digital artforms with citywide data, contributing to and becoming part of the fabric of post internet art, offering further insights into these stacked multi-layered entangled systems for other artists.

The artworks which are software interfaces serve to disrupt flows within disciplines other than art, including computing and urban studies. The data visualisations are not informatics, although these systems do relate and articulate an understanding of smart cities, and also place the viewer experientially inside the panoptic surveillance gaze. The technological camera systems allude to self and identity, but again displaced intention and multiple exposure fuels a vision that privacy and multiple perspectives exist in parallel realities. The poetics of the data to create abstract understanding of the new shared virtual space is laboured and embedded with an invisible agency that demonstrates understanding of another reality separate from our own, but which we complicity build and are part of.

Insights are offered via the artworks, objects, and platforms, which are evidenced through the methods developed. Critically, by experiencing these artworks in relation to surveillance and privacy, further reflection is needed since we have become directly enmeshed in the dispositional technological landscape we are now embedded within.

This is not a sublime data poetic landscape but a collective, conscious, politicised and attacked landscape of surveillance capital. The extremes to which these myriads of data flows create new meaning have only just started. These works suggest alternative ways to understand and experience the dual functionality of technologies that on the one hand seek to liberate us but on the other actually create more borders and divisions.

Thus what is unknowable at the start of the process and the research is made tangible through the objects, and understandable through the discourse and dissemination via numerous international exhibitions.

The audience has become an active agent in revealing the hidden structures that give the data maps and artwork their form. The agency of the real-time city is made real by these representations of the data, and has relevant artistic and theoretical contexts situated in relation to surveillance and new cultural mapping.

Final Thoughts

The ubiquitous architecture of monitoring, analysis and control and all these outlays of genius and money are geared towards keeping users '*plastered to the social mirror*' (Zuboff, 2019). This surveillance and data monitoring combines by design to '*home the herd*' as ethnologists call it - as everyone becomes penned in. The surveillance of everything has left no space where there is a 'backstage' where one can be oneself and not be onstage (Goffman, 1959). The implication is that there is nowhere to hide our true self and that the herd has become a malleable system that can be directed, and exploited.

The purpose of all this aligns itself with these panoptic theories and by design now encompasses what the author describes as *'the spread to the edges of these systems'* which is referenced in The Nemesis From Metropolis to Megapolis To Ecumenopolis. The whole world is penned in by algorithmic functions from corporate systems like Amazon, Google and Facebook, to a newer total surveillance system in China that tracks everything as a social status system ranking people for all to see completely on stage and in public. Whether by design, intention or desire, we have nonetheless brought ourselves to this position by our own agency. What Jack Burnham, the pioneer of cybernetic art, called system aesthetics as far back as 1968 is today actually interwoven within panoptic aesthetics implicit in the exhibited plastic, sculptural and visual forms.

In this, the increasingly digitised city, Kitchen (2015) suggests that data is collected without people's knowledge,[103] but really he means permission. As David Lyon has also observed, ‘billions of people will become instruments of surveillance and control’ (Lyon, 2007, p.170). The Nemesis Machine and other artworks allude to this complicity, this coercion inside the invisible fabric that is drawn upon in the artworks creating this unique contribution. Data could be considered the panoptic medium of the information age.

Finally, it is the author's assertion that ultimately it is solely as artworks that the research rationale should be represented, experienced and understood. Art alludes to the experiences we cannot speak and to expressions of space that can only be described in novel ways, whose overall objective is to understand the world better. As Charlie Gere notes in an essay concering the author's work:

> 'Art does not, indeed cannot tell us about things in the way that science or philosophy does, but it can tell us something about how we can come to know and understand the world into which we are flung. To put it another way it offers us an insight into the act of knowing and the way that that knowing is structured and determined. Works of art set us up as observers of different sorts, according to the dominant epistemologies of the context in which they are made. Thus to look at a work of art made in a context different to that in which we find ourselves is to be given a potential insight, however partial, into a different way of thinking about and representing the world' (Gere, 2014).[104]

It should be also stated that these works of art were not made in isolation from research or academia.[105]

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[103] Susanna Zuboff (2019) also believed we walked unknowingly in the age of surveillance capitalism. I believe both Kitchen and Zuboff are wrong. These systems are planned and designed and the planners had insight into their own objectives. People are knowing and they are complicit but to the degree to which they openly acknowledge this is up for further debate and research.
[104] This essay 'Stanza's Object-Oriented Aesthetics' by Charlie Gere is archived here https://stanza.co.uk/about/essays/GERE_StanzaV3.pdf
[105] They were seeded in the author's AHRC creative fellowship with at Goldsmiths College (2006 - 2009)

> 'What hit me suddenly was the congruence between a work of art and a scientific or mathematical model... that is a constructed object (which can be either physical or ideal or both) which does not itself transmit or encode knowledge but allows us to interrogate or observe it to enable us to derive knowledge' (Szpakowski, 2016).

The overtly pluralistic situation of the practice, incorporating sensor systems, online networks, computer code and display technologies created a rich tapestry of understanding which is evidenced only through experiencing the online interfaces, networked systems, sonifications and fabricated electronic sculptural objects.

Through process and practical application the work discovered that the networked online cities spaces could overlap without borders creating these new visual and sonic experiences, and hence the body of media artwork presented. These are identified and formed by the needs of the practice; however the work is collaborative by its technical dependency on operating systems and proprietary technologies (computers and sensors), and interdisciplinary by its very reliance on other fields which include urban studies and computing.

Graham Harman in his Object-Oriented Ontology states, '*knowledge is taken to mean the human recognition of truth, so that knowledge and truth comes as a pair*'. He suggests that knowledge and truth are the preserve of science. However, he also suggests '*noone is in the possession of knowledge or truth*' (Harman, 2018, p.6). Harman cites Socrates whose love of wisdom is at the core of the discipline. This is the pursuit of knowledge through the '*love*' of the art that facilitates this arts practice. Through new knowledge, new objects to understand the world create further understanding; this has been the pursuit at the core of the research. This in turn leads to more contextually relevant questions and is the yardstick by which any inquiry is reviewed. If knowledge must be evidenced, it is in its purest sense as art.

This leaves the research as a form of practice in search of more questions: How can the collective body reclaim control over the data space using network technologies?

How will artificial intelligence (AI) and machine learning affect the governance of the urban landscape? How will the technologies of today remain of value to artists as these systems become obsolete?

This landscape of monitored data is being observed via a new artwork, a collaborative custom phone app.[106] The purpose is to put the user in control of the data, creating a public engagement artwork within urban space, and now to create a new artistic context where such collaborations might lead to a new understanding of the shared networked technological landscape and our future relationship to it. Thus the process of engagement allows one to once again become aware of one's actions in the system and the complicit nature of this behaviour.

In summary:

- It is the digital artworks which elicit the unique contribution to knowledge in the field of media art, i.e. the fused mashed-up data cities and real-time performative city experiences, all re-presented online as systems of control and systems that demonstrate how these systems control.

- Furthermore the artworks argue that we are complicit via our social agency in relation to these surveyed and monitored data-spaces within the city and thus demonstrate that we have become entangled within the technological layers that the artworks are communicating.

- Finally the body of work The Emergent City both frames and establishes all of the author's artworks in its own category; panoptic aesthetics.

Can we use new technologies to imagine a world where we are liberated and

[106] Velocity (2019) . By combining and sharing everyone's data in this artwork the participants become a large performing group making a playful engagement within city http://velocity.stanza.co.uk/

empowered, where finally all of the technology becomes more than gimmick and starts to actually work for us or are these technologies going to control up, separate us, divide us, create more borders? (Stanza 2004).

8 APPENDIX

Exhibitions of the artworks presented in sections 3 - 6 Public Works or Outputs[107]

3.1 Sensity

Warehouse 9 Copenhagen, Denmark (2017)
Future Places in Porto, Portugal (2010)
V&A at Decode show London, UK (2008) and (2009)
Pace Digital Gallery New York, USA (2010)
Plutopia SXSW Texas, USA (2009)
Radiator Festival and Exhibition, Nottingham UK (2009)
Biennale of Sydney Revolutions, Australia 2008)
Smart City The Salon Honnorat Cité Paris, France (2008)
Motomix São Paulo, Brazil (2007)
NIME. New York City, USA (2007)
Share IT Turin, Italy (2007)
Dislocate at Koiwa Art Space Tokyo, Japan (2007)

4.2 Gallery, Invisible Agency And Cultural Behaviours

Plymouth Arts Centre, UK (2008)

4.3 The World of New Possibilities

Towneley Park as part of AND festival Burnley, UK (2010)

4.4 Data Data Data

FACT Liverpool, UK 2010

5.1 Sonicity. Songs of Atoms, Time And Space.

[107] For a full list of exhibitions see. https://stanza.co.uk/about/awards.html

TSSK Trøndelag Centre for Contemporary Art Trondheim, Norway (2014)
Filmwinter Expanded Media Stuttgart, Germany (2012)
Lanternhouse International Ulverston, UK (2010)

5.2 The Singing Trees
Hyde Park, London (2008)
Confluence in Falmouth, UK (2013)

5.3 Body. 01000010011011110110010001111001
Bruges Museum, Belgium (2015)
TSSK Trøndelag Centre for Contemporary Art Trondheim, Norway (2014)
ODI (open data institute) London (2012)

6 The Nemesis Machine

The New School Kellen Gallery NYC, USA (2020)
Samek Museum, USA (2020)
FOS Festival of Speed Goodwood, UK (2019)
DAS CUBO Bologna, Italy (2019)
Ffoto Gallery Diffusion, Cardiff Wales (2019)
Cynetart Dresden, Germany (2018)
Speculum Artrium Decades Trbovlje, Slovenia (2018)
Measures Of Life Lumen, UK (2018)
Future Festival Nesta, UK (2018)
Beyond The Seven Warsaw, Poland (2017)
York Art Gallery, UK (2017)
WRO Art Centre Wroclaw, Poland (2017)
The Internet of Things World Forum Cisco Systems, London (2017)
Dundee Contemporary Arts at Centrespace (VCR) NeoN, Dundee (2016)
Hacking Habitat Art of Control Utrecht, Netherlands (2016)
The Intelligent City Arentshuis Bruges Museum, Belgium (2015)
TSSK Metamorf Trondheim, Norway (2014)
Centre des Arts d'Enghien-les-Bains Paris, France (2014)
Watermans Gallery Brentford, London (2013)
New Technological Art Award Ghent, Belgium (2012)
Share Festival Torino, Italy (2012)
Gogbot Festival Enschede, Holland (2011)
Lanternhouse International Ulvertson, UK (2010)

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