OBJECT GEOGRAPHY: THE INTERNET OF THINGS

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This paper investigates how objects in the Internet of Things, endowed with informational clouds, could create a new layer of complex relationships that were previously not visible in our networks. Consequently it allows us to rethink our understanding of the structure and agency of a network, by examining the pattern of interactions represented by how people to people, people to things, and things themselves are connected to one another.

The emerging phenomenon known as the Internet of Things (IOT) refers to the technical and cultural shift anticipated as society moves towards a ubiquitous form of computing that facilitates the connection of everyday objects and devices to all kinds of networks. The analog bar code that has for so long been a dumb, encrypted reference to a shop's inventory system will be superseded by an open platform in which every object manufactured will be traceable from producer to distributor, and potentially every single person who comes into contact with it following its purchase. Furthermore, every object that comes close to another object and is within range of a reader could also be logged on a database and used to find correlations between owners and applications.

The Internet of Things creates a link between concrete objects and abstract data, producing a hybrid of physical and electronic spaces that enables communication and interaction between people and things, and things themselves. It is an all-encompassing framework to reflect on and design towards more digital connectivity, a system that is local and global, accessible in real-time from any location. Through item based tagging and identification, the Internet of Things will take ubiquitous computing – anytime and anywhere communications – to the next step in networking: 'anything communications'. However the Internet of Things is at risk of simply becoming a platform whose primary benefit is to offer improved indexing and tracking of manufactured consumer goods from cradle to grave. Therefore this paper aims to re-contextualise the Internet of Things, and explore theory relating to the attachment of data to an object, and as a result the role objects might have in our networks.

THE IOT AND INFORMATIONAL SHADOWS

The significance of Internet of Things is that through technologies like RFID and 2D barcodes, it offers a low-impact way to 'import' physical objects into the data-sphere and endow them with an informational shadow (Greenfield, 2006). As the Internet grows, will we see it encompass more and more elements of the real world, as "ordinary objects, from coffee cups to raincoats to the paint on the walls, would be reconsidered as sites for the sensing and processing of information…where ubiquitous means not merely in every place, but also in everything" (Greenfield, 2006). The Internet of Things leads us into a new era of ubiquity, where the 'users' of the Internet could be counted in billions and where humans may become the minority as generators and receivers of traffic, and instead most of the traffic could flow between devices and all kinds of 'things'. Radio Frequency Identification (RFID) is seen as being a key enabler in the Internet of Things due to its ease of distribution, low cost, technological simplicity and is therefore a logical candidate for bottom-up tracking and tracing of things, and the ways in which

things move around. As a pull technology, the RFID reader emits energy so that a tag provides its unique number, identifying itself. In combination with the Electronic Product Code, the next generation of production identification that identifies objects in the supply chain, it becomes possible via an Object Name Server to map the object to a IPv6 address in a database, and through Physical Markup Language represent data about that object. This means you can track a bottle in your room, provided there is a reader in your door, floor or building, and through a simple web query it can be accessed via the web, for example from Tokyo (Rob van Kranenburg, The Internet of Things: A critique of ambient technology and the all-seeing network of RFID, Amsterdam: Institute of Network Cultures, 2007). As an informational shadow is created for every object connected as a node to the Internet of Things, what does the shadow look like and what is its affect on an object?

Most implications of an Internet of Things consist of programs resulting through the convergence of identification and location technologies related to the manufacturing process for consumer goods and their associated logistical systems, such as stock control and product tracking. These systems offer the ability for the condition of an object to be recorded in a variety of forms and streamed to databases that can be correlated and mined to ensure that things, for example, are in the right place now or have been in the right place in the past, have been kept at the right temperature and handled by the right people (Speed, 2010). Sterling terms theses objects 'Spimes' – objects that can be tracked through space and time, and throughout their lifetime. Spimes are regarded as "material instantiations of an immaterial system, they're virtual objects first and actual objects second", which "begin and end as data" (Sterling, 2005). From books to frozen peas, parcels, to even people, things move through scanners to update their location; if that location has particular properties, then aspects of its condition complement the data that is associated with the object. "In this way, things carry data about the world around them" (Speed, 2010).

However the ubiquity of smart-phones and online platforms such as StickyBits, Itizen and Tales of Things (http://www.talesofthings.com), offers individuals the ability to re-appropriate previously closed channels and tag physical objects with memories, stories and media content. Anders (2001) discusses the ability of an object to be the methodology for the mapping of space and information, a 'cybrid reality' – "I have a physical object here that notes my handling of it and displays its contents to me in this way". The change in informational processes become spatial in nature and in direct relationship with the physical, resulting in a virtual and physical world that correspond with each other, comprised of entities that 'cybridize' within that world. This ability for material artefacts to become an interface to the Internet of Things is addressed in the artwork RememberMe (http://fields.eca.ac.uk). The RememberMe artwork was a collaborative project with the Oxfam and FutureEverything 2010, where people who donated objects were asked to tell a brief story about them into microphone – where they acquired it, what memories it brings back and any associated stories. These audio clips were then linked to an RFID tag and QR code and attached to the items as they joined the shop's stock. Visitors to the shop, including conference delegates were able to use bespoke RFID readers, or their own smart phone to browse artefacts that were displayed amongst the many thousands of other objects. Labels highlighted the RememberMe objects and once triggered, speakers located in the shop replayed the previous owners story, evoking a ghost from the past. Once tagged the objects were in the public domain for purchase by other members of the community, and the project's iPhone and Android apps allowed new owners to access old stories but equally importantly, add their own.

However when we are discussing the attachment of data to objects, whether it's labeled 'Spimes' or 'Cybrids', I question whether Greenfield's 'informational shadow' is the right analogy to use. The term shadow by its definition implies that it is the object that casts the information – the data must be read

from it. However the Internet of Things can provide a technological framework for data to be written onto objects, in situ or remotely, allowing the data to cast its own shadow on to objects that are either present in the real world, or no longer exist having been lost or destroyed. In artistic practice, negative space is used to refer to the space around or between the subject(s) of an image, and not the subject itself. The surrounding space is used to artistic effect as the 'real' subject of the image, and is used to form an interesting or artistically relevant shape. The importance here is that it is the immaterial space that is used to define the method of viewing the representation of the object for the audience. In the same way, objects in the Internet of Things become abstracted manifestations of their data whose immaterial representation may differ from their physical form. When we stop examining the physical object, and instead start seeing the immaterial data that surrounds it, the form of the object begins to disappear – by concentrating on what doesn't exist, the negative space, we can more accurately define the boundaries of what does exist. When we view an object in the Internet of Things, foremost we are viewing its data, and its form lies in the negative space created by the associations between databases tables and indexes. Therefore this author proposes it is more accurate to describe objects in the Internet of Things as having informational clouds, and like clouds which form part of a complex weather systems, objects in the Internet of Things do not exist in splendid isolation, but as part of network. Therefore question arises, what happens with these informational clouds begin to interconnect?

LOOKING THROUGH THE CLOUD

Ubiquitous digital devices are built into the world of everyday life, of social relations, places and things (Richard Coyne, The Tuning of Place, London: MIT Press, 2010), and the Internet of Things is evolving into a "conceptual framework for understanding how physical objects, once networked and imbued with informatic capabilities, will occupy space and occupy themselves" (Bleecker, 2006). This provides a technological paradigm under which we can re-conceptualise new forms of spatial arrangements.

Through an enormous quantity of new associations being generated via thing to thing and thing to people communication, The Internet of Things allows us to see a whole set of pattern relationships that were previously not visible in our networks – "society itself is to be rethought from top to bottom once we add to it the facts and the artefacts that make up large sections of our social ties" (Latour, 1992). Society, organisations, agents and machines are all effects of patterned networks generated through the interactions of actor-networks, the observation of which can only be achieved by tracking the traces left when relationships, or associations, are being produced between intermediaries (Law, 1992; Latour, 2005). Social networks are comprised by the patterns of casual interconnection and interdependence among agents and their actions, as well as the positions they occupy (Jose Lopez and John Scott, Social Structure, Buckingham: Open University Press, 2000) – in other words their relational structure is the sum total of all the social relationships of all the agents at a given moment in time.

Actor-Network Theory (ANT) can be seen as a tool for exploring and describing how the social is assembled by way of technologies; objects and artefacts, and its import is one of agency, specifically responsibility that is distributed equally across entities, including a host of nonhuman ones not normally seen as exercising agency at all. (Latour, 2005). ANT does not typically attempt to explain why a network exists; it is more interested in the infrastructure of actor-networks, how they are formed, maintained and how they can fall apart. Actor-Network Theory incorporates what is known as a principle of generalised symmetry; that is, what is human and non-human (e.g. artefacts, organisation structures) should be integrated into the same conceptual framework and assigned equal amounts of agency.

An actor is not the source of action but the moving target of a vast array of entities swarming towards it, and action should be felt as a set of agencies or translations between mediators that may generate traceable associations. (Latour, 2005). In the Internet of Things, "agency happens with the ecology of networked publics –streams, feeds, trackbacks, permalinks, Wiki inscriptions and blog posts" (Bleecker, 2006). In other words the agency lies in the flow of data between networked objects. The Space of Flows is Castels' (1996) theory relating to network society and technologies role in a new type of space; made up of movement that brings distant elements – things and people – into an interrelationship through synchronous, real-time interaction. Flows are understood by the purposeful, repetitive, programmable sequences of exchange and interaction between physically disjointed positions held by social actors in the economic, political and symbolic structures of society (Castells, 1996). The Space of Flow is defined as consisting of three elements – "The medium through which things flows, the things that flow, and the nodes among which the flows circulate" (Stalder, 2001). The Internet of Things can be understood in terms of these three elements – tag/reader, data and objects.

Through contextualising the Internet of Things through Actor-Network Theory and the Space of Flows we can conclude that an object's agency, meaning, functionality and value is deduced from the relationship created by its informational cloud when inserted as an actor into an intersection of a flow in a network – things are less defined by their intrinsic qualities but more by their relational position to one another (Latour cited Stalder, 2003). McLuhan (Marshall McLuhan and Barrington Nevitt, Take Today: The Executive as Dropout, Ontario: Longman Canada Ltd, 1972) states the "meaning of meaning is relationship", and by this he meant, that there is no content without context and that the importance of a piece of information, its real meaning, changes depending on what it is related to. The difference between data, information, and knowledge is the amount of relationships that are contained within it. In other words function, value and meaning in the space of flows are relational and not absolute and as the network changes – as old connections die and new ones are established as the flows are reorganised through other nodes (Stalder 2003), a nodes agency, meaning, functionality and value changes too. We cannot help but view the world in terms of unseen relationships where the things-in-motion illuminate their social context.

AT THE CENTRE OF THE FLOW

Actor-Network Theory proposes that the structure of networks consists of nodes both human and non-human, where associations between the nodes exist in a continuous Space of Flow. The Internet of Things offers a technological framework for this theory, connecting everyday objects to networks and providing them with a rudimentary knowledge about what they are and their environments they inhabit – given the fact that an object through a tag/reader can query a database to discover associations about itself, and any other object within its vicinity. This interconnection of objects may determine the joint effect they have on the world at that moment, as the organisation of a synchronous real-time relationship between the nodes of a network, gives the network as a whole the ability to exert a causal influence. "Agents residing on one scale start producing behaviour that lies one scale above them: ants create colonies; urbanites create neighbourhoods; simple pattern-recognition software learns how to recommend new books. The movement from low-level rules to higher-level sophistication is what we call emergence" (Steven Johnson, Emergence, London: Penguin Books, 2001). The source of relational emergence is the organisation of nodes, and the maintenance of a set of substantial relations between the nodes that constitute them into a particular kind of whole at a particular moment in time, and thus allows a node to produce causal impact in its own right (Elder-Vass, 2010).

In the study of Human Geography we are constantly reminded of how people shape their world and of how people and places vary across time and space. Places are constantly changing and people are responsible for these changes. People create cultures, values, aesthetics, politics, economics and more, and each of these affects and shapes places (Erin Fouberg and Alexander Murphy, A. and H.J de Blij, Human Geography: People, Place and Culture, Hoboken: Wiley, 2010). The structure of a network, the relations among network members, and the location of a member within a network are critical factors in understanding social behaviour. Complex, dynamic social systems are analysed in terms of stabilising and destabilising mechanisms, and traditionally it is only human agents who play strategic roles in these processes. Institutions and cultural formations of society are carried by, transmitted, and reformed through individual and collective actions and interactions. These social structures help to create and recreate themselves in an ongoing developmental process in which collective agents play constructive as well as destructive and transformative roles in the context of complex sociocultural arrangements. These arrangements of social life involve time, space and place as a constitutive factors in the construction and reconstruction of what people do and in the way they do things together, as active agents with their distinctive characteristics, motivations, and powers contributing to the reproduction and transformation of our networks. In other words societies are composed of the relations between people, and the ramifications and latticework of those relations constitute the structure of society.

However through re-contextualising the Internet of Things from a relational emergentist methodology, within the context of Actor-Network Theory and the Space of Flows, it raises questions about how our social networks will be constructed, destructed and transformed by the interactions represented when people to people, people to things, and things themselves are interconnected. The behaviour of the relations between the nodes of a network in particular temporal and spatial contexts defines the behaviour of the network as a whole. Networking objects means we could possibly gain new insights into how we make places, how we organise space and society, how we interact with each other in places and across space and time, and how we make sense of others and ourselves in our locality, region, and world. As objects are treated like code, the messages they encode will emerge from the pattern of social relations being expressed, allowing the Internet of Things to provide the meta-data that enables clusters of data to self-organise, assembled out of an unthinkable number of associations created by agents both human and non-human.

References and Notes:

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