Deconstructing the smart Home: AI vs Second-order Cybernetics

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As a result of the fast-growing market of the *smart* home the embedded algorithmic logic, based on the Internet of Things technology, is permeating into our lives transforming the experience and understanding of it through data collection, data aggregation and automation. Under market principles such as efficiency and optimization, this technology branded as the epitome of innovation claims to *understand*, *know* and *predict us* (*Algorithmic Paradigm*). However, its origins trace back to AI, a deterministic foundational epistemology—very much revived these days in Silicon Valley. Although considered as the main way forward, through contrasting it with second-order cybernetics, it is being revealed that a more constructivist epistemology is needed to address human complexity.

Keywords: smart home, AI, second-order cybernetics, algorithmic paradigm, epistemology

The Smart Home

Historically, technological developments have played a key role in the way we understand how cities operate as well as how they transformed our daily routines within. Over the last few decades, the technological advancement in combination with reductions in the cost of processors, network capability and sensors, led in the rapid development of Internet of Things (IoT) industry. This development led to one of the most significant technological shifts: the *smart* age. While its growth is undoubted, the speed and expectations of it have resulted in a disparity on projection. Cisco stated that in 2020, 50 billion objects would be connected (Evans 2011), while Gartner (2014) has estimated that 25 billion connected 'things' will be in use by 2020. Due to advantages in optimisation, efficiency, tracking, managing resources and reducing costs IoT technology was successfully applied in the industry since its introduction, in the late 1990s.

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The aspiration of broadening led to the incorporation of a wide range of *smart* devices into the built environment which fueled the fast-growing market of the *smart* home. It is forecasted that the IoT industry will be the world's most massive device market, where the home is "gaining momentum" [1], grows at a "steady clip" [2] and *smart* home products are 'gaining steam'. These data-driven devices will generate a radical shift in architecture once embedded in the architectural infrastructure itself. As Rem Koolhaas [3] suggests,

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> "*architecture has entered into a new engagement with digital culture and capital—which amounts to the most radical change within the discipline since the confluence of modernism and industrial production in the early twentieth century […] for thousands of years, the elements of architecture were deaf and mute—they could be trusted. Now, many of them are listening, thinking, and talking back, collecting information and performing accordingly.*"
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> Korody, 2015

As Koolhaas [4] points out in relation to *smart* technologies and architecture "this shift has gone largely unnoticed because it has not taken the form of a visible upheaval or wholesale transformation. To the contrary, it is a stealthy infiltration of architecture via its constitutive elements." The *smart* home market includes areas such as home security, heating control, lighting automation, various household appliances and object communication systems (e.g. home chats, that allow the users to communicate with appliances, and assistants, like Amazon's internet-connected speaker Echo and recently Apple's HomePod). *Smart* features range from automating, controlling, and monitoring the device itself, to learning users' behaviour and making suggestions. Leading companies in the *smart* home industry are technological giants such as Google (Nest), Apple (Home Kit), Amazon (Echo, Dash buttons) and Samsung (SmartThings) [5]. Most of these domestic examples are exhibited at the Consumers Electronics Show (CES) that takes place annually in Las Vegas. On 2017, *smart* homes were the key focus of CES [6].

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The series of IoT domestic devices come with industrial principles and an algorithmic logic. As Wajcman (2015) notes,

> *"with few exceptions these visions of the domestic space celebrate technology and its transformative power at the expenses of the home as a lived and living practice […] domestic spaces are subject to a quite different set of considerations than those governing the offices, factory floors and workplaces within which information technologies have conventionally being deployed."*
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> Wajcman, 2015

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Through algorithmic processes of the embedded *smart* technology, the complexity of the domestic space is often replaced by a quantified approach. *Smart* market, often envisions the users' 'upgraded life' under principles such as productivity, security, efficiency, optimization, convenience and automation. As Wajcman (2015) describes the IoT-home industry exhibited at CES as "the attempt to find home applications for the functions that computers have excelled at in business and scientific settings, information processing and numerical processes".

Algorithmic logic: Our life through numbers

Smart devices through sensors extract data from our behaviour, analyse it through algorithms, to often include automatic decision-making. I characterize this quantified approach inherent in current notions of *smart* technology, as the *Algorithmic Paradigm*. The Algorithmic Paradigm represents and models the data of the user's body and surroundings (domain of behaviour), aggregation of data (the decision-making process uses advanced analytics to predict probabilistically how an individual is expected to behave in the future e.g. big data and machine-learning) and automation in real time (algorithmic control and the potential of it to change its procedures without informing the user). In branding terms, the *smart* industry claims that *smart* objects are *conscious (e.g. Nest)* and that they can *know, understand* and *predict us*. According to

Antoinette Rouvroy (2012), this reductionism or 'data behaviourism' has several implications. She defines the concept as "the way of producing knowledge of future preferences, behaviours or events without considering the subject's psychological motivations, speeches or narratives, but rather relying on *data*" and describes these algorithmic issues as "indifferent to the causes of phenomena. 'Data behaviourism' is anchored in the purely statistical observation of correlations (independent from any kind of logic) among data collected in a variety of heterogeneous contexts". This *smart* vision of the domestic space is characterised by the premise that *smart* objects are constantly sensing and 'doing things for you'. This approach towards dwelling, risks disregarding human individuality and our complex life. As Nest CEO, Tony Fadell (2014) indicated at a panel discussion at the Venice Biennale 2014, when asked about the values of the technology, he replied: "you are always in control. So these products don't take control away from you. All we're doing is we're learning from your habits. So, we're not imposing anything on anyone. In fact, in most cases we're actually just educating and giving you feedback on what your what your abilities are".

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Aiming for *smartness* to 'solve' or 'fix' a problem might be at first sight appealing. However, the interweaved dynamics between environment, surrounding infrastructure, objects and humans makes it impossible to grasp such complexity through numbers. When reflecting on *smart* technology, the problem, the problem-framing, and the agenda of the market related to it need to be significantly considered. Morozov (2013) refers to 'technological solutionism' in his book To Save Everything Press Here: Technology, Solutionism and the Urge to Solve Problems that Don't Exist as the tendency of technologists to create, define and 'solve' 'problems' quickly, through algorithms. He continues indicating, "what is contentious is not their proposed solution, but the definition of the problem itself" and asserts "solutionism and quantification are thus inherently linked". Considering that our life is increasingly being delegated to algorithms, it is relevant to question how the algorithms get to *know* the world. As Gillespie (2014) suggests, algorithms are mathematical procedures [claiming to] producing and certifying *knowledge*. The

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algorithmic assessment of information, then, represents a particular *knowledge logic*, one built on specific presumptions about what knowledge is. Gillespie (2014) calls "the promise of algorithmic objectivity, the way the technical character of the algorithm is positioned as an assurance of impartiality, and how that claim is maintained in the face of controversy". These *smart* technologies are not free from bias. *Smartness* in dwelling has systemic and socio-political implications which go beyond the technical domain of efficiency. As Markoff (2015), notes "the best way to answer questions about control in a world full of *smart* machines is by understanding the values of those who are actually building those systems." Behind the *smartness* there are ideologies that define how the world is being *known*.

AI was created by the Artificial Intelligence Group, founded at the MIT, by John McCarthy and Marvin Minsky, in 1958. As John McCarthy (1955) declared in relation to the foundational principles of the nascent field "the study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it." Paul Pangaro (2013) points out that AI is characterized by "the cultural view of the brain as a computer" and that for AI the stored *knowledge* of the real world constitutes *intelligence* leading to the idea that *knowledge* can be a commodity inside a machine. By eliminating the complexity of daily life (non-linearity) and the observer's interpretations (subjectivity), the ruling principles of numerical efficiency diminish the human into a machine-like operator. As Morozov (2013) argues, technology should allow humans to "continue exercising the tough, challenging choices that distinguish them from machines". While recent approaches to machine-learning 'declare victory' for intelligent devices—because they can now adjust from experience—AI's logic structure still dominates. In Silicon Valley, the epicentre of high-tech corporations and start-up culture, AI constitutes one of the hottest trends. Machine-learning techniques have led to a dramatic revival of interest with 'deep learning', the latest excitement [7]. This comeback has also led into digital deterministic trends such as rational-choice, behavioural

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design and nudge among others. The *Algorithmic Paradigm* strongly interweaves with AI. In contrast to AI's first-order epistemology—which aims (and claims) to know the 'world as it is' the significance of second-order cybernetics as an alternative, constructivist epistemology contradicts this assumption. Second-order cybernetics is a movement that emerged around 1968 from the 'cybernetics movement', originated in the Macy Conferences (1946-1953) more than a decade before AI. As Glanville (2002) indicates about the field "second-order cybernetics presents a (new) paradigm in which the observer is circularly (and intimately) involved with/connected to the observed. The observer is no longer neutral and detached, and what is considered is not the observed (as in the classical paradigm), but the observing system. The aim of attaining traditional objectivity is either abandoned/passed over, or what objectivity is and how we might obtain (and value) it is reconsidered […] in this sense, every observation is autobiographical". As opposed to the current linear directionality of algorithmic logic, second-order cybernetics implies the extension of control as a mutual notion, since the 'controlling' and the 'controlled' elements of a system share a goal. A relevant second-order cybernetics practical and conceptual example, related to how second-order cybernetics, addresses human complexity is Heinz von Foerster's (1984) model of *non-trivial machines*. In contrast to *trivial machines* which are not influenced by previous operations (history independent), are analytically determinable, therefore predictable, the non-trivial machines are history-dependent (every operation changes the operator), analytically indeterminable, hence, unpredictable. Such approach addresses the complexity of cognitive behaviour and highlights the computational limits.

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The user of the *smart* home is not a consumer who receives normative outcomes from the algorithms, but a subject who is able to reflect on data and behaviour. By a systemic understanding embracing the impact of context and experience, by valuing the observer's observing, and by considering the meaning that is constructed, a second-order cybernetics approach is more suitable to address human complexity. In opposition to AI, this epistemology leads to the acknowledgement of the limitations of *smart* devices and

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the impossibility to grasp the human condition through algorithms. While the potential of *smart* technology, in specific cases, can't be doubted, humans must not be envisioned as efficient consumers. The reflection on the current epistemological stance embedded in the IoT technology as well as the consideration of the limits and implications of algorithms are of great significance. Applying second-order cybernetics provide opportunities to rethink the *smart* home. As Morozov (2013) indicates,

> *"a truly smart system will find a way to turn us into more reflective, caring and humane creatures. Technologies can assist in the mission, and both, technologists and social engineers, guiding them would have to acquire a very different mindset."*
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> Marozov, 2013

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