Species of (Code) Spaces

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ABSTRACT

As digital technologies make a powerful impact on the production of space and software mediates most of our everyday activities, we find ourselves living, working and interacting in the common ground of code and space. The environmental diffusion of computing should be considered in relation to the increasing acceleration and simultaneity of socio-spatial and economic processes, characteristic conditions of a dynamic spatial ontology that evolved during the past decades, changing the ways we inhabit, design and think about our environments. By following the gradual hybridization of space and time, this essay investigates the ways in which software and communication networks infuse space with temporal qualities, enhancing its inherent mediality with successive layers of meaning. An account of this in urban scale is the endeavour of smart cities, a fluid field of tension and negotiation between centralized managerial visions and bottom-up participation and appropriation initiatives. Finally, as spatial production becomes increasingly transdisciplinary and the digital turn reaches a certain level of maturity, the role of the architect and the architectural object changes drastically. Cedric Price famously argued that the best solution to a spatial problem is not necessarily a building, but the question is still pending – could it then be code?

KEYWORDS

Space; Architecture; Media; Code; Software; Smart Urbanism.

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1 | INTRODUCTION

> *"In the Khan's mind, the empire was reflected in a desert of labile and interchangeable data, like grains of sand, from which there appeared, for each city and province, the figures evoked by the Venetian's logogriphs."* (Calvino, 1972, p. 22)

The ways in which the ongoing hybridization of code and space affects our everyday life is a topic of discussion that unites scholars and practitioners of numerous disciplines. It is a field that seems to be reaching a certain level of maturity, as approaches to the matter supersede the initial purely enthusiastic or oppositional viewpoints. Various schools of thought are unfolding around the alliance of the virtual, the physical and the qualitative gradients in-between. This diverse community uses an arsenal of critical thinking and interdisciplinary methods to address emerging issues, dangers and possibilities as they arise. In such a pluralistic frame, this essay will attempt to outline the current situation and organize it into four categories. It is imperative to note though, that these allow for an interflow of ideas and practices, forming a network of discernible thematic

clusters, rather than exhaustive or definitive groups of concern.

The first part of this essay serves as a preparatory piece for the following categories. It considers the evolution of the fundamental notions of time and space in relation to the production of the latter. In doing so, it tracks the ways in which breakthroughs in fields traditionally external to architecture made a decisive spatial impact. The rest of this essay unfolds in the context of the ongoing compression of the parameters of time and space.

The relationship of space and software may be addressed through the following three key points. First come the ways through which software escaped the confinement of our personal computers to inhabit the "hardware" of our physical world. Ubiquitous, pervasive or situated, computing becomes spatially active in transforming the experience and production of urban and domestic spaces, which are now produced through a process of transduction orchestrated by software (Kitchin and Dodge, 2011, p. 65). This omnipresence of code is manifest through different forms and across different scales, from wearables and IoT devices to urban systems – or even radically new smart cities.

The third part seeks to map the ongoing discussion on smart urbanism. First, this essay will briefly identify the perils of smart cities envisioned by corporate approaches. The following section will present a collection of ideas from the theory of cybernetics. Those cybernetic concepts and examples, if appropriated accordingly, may prove invaluable in the effort to resolve the defects of the prevalent smart city paradigm. The last section showcases alternative visions of a participatory, open-sourced city model that supersedes the epistemologies and ideologies of the previous two approaches.

There is also a third point concerning the pollination of logic and structure that infuses virtual places and cyberspaces with gradients of spatiality. This tradition can be traced back to the first steps of the world wide web and interface design, when they inherited characteristics of actual physical spaces and spatial practices. Websites adopted analogies to urban structures, while their user experience often resembled real-life wayfinding. However, this point is not in the scope of this essay, for the sake of exploring further in depth the relationship between code and physical space.

Before exploring the aforementioned points in greater depth, it may be appropriate to first identify contemporary notions of time, space and their relationship. The following brief narrative of its evolution is an attempt to draw ties between time-space and the emerging hybrids of media-architecture and code-space. As a matter of fact, the ways architecture and media (and thus space and code) are thought of, experienced and produced, are shaped according to the current concepts of time and space.

2 | TIME AND SPACE: TWO CONVERGING PARALLELS

The nature of space and time is an enduring topic in the history of philosophy. The Enlightenment conceived of space and time as absolute dimensions, which is a historical byproduct of Newton's work. The consideration of time and space as separate, parallel entities was widely accepted for centuries, echoing the platonic division of the arts into time-bound and space-bound entities. Published in 1766, Lessing's Laocoön took this argument further, "suggesting that temporal and verbal arts, such as poetry and music, are superior to the spatial arts, such as sculpture and architecture" (Mitchell and Hansen, 2010, p. 105). A few decades later, Goethe would compare architecture to 'frozen music' (Walker, 1814, p. 282), almost as if his appreciation of the former emanated from its similarity to the later, compromised in static form. At this point, it is worth mentioning that throughout modernity, the building, architecture's main product, was often regarded as a kind of "inhabited sculpture" (see Brancusi) and thus, a merely spatial artifact.

The notion that time and space are two absolute and independent dimensions was later undermined by Einstein's theory of relativity. Strangely enough, although his time-space continuum made a tremendous scientific impact at the time, it seems like an equivalent re-conceptualization of spatial ontologies appeared only decades later – arguably, in our times.

2.1 A BRIEF GENEAOLOGY OF SPACE THROUGH TIME

The production of substantial theoretical work on the ontology of space emerged mostly after the 1950s, rendering spatial thinking roughly fifty years old. It was then, that a theory for an absolute ontology of space was clearly articulated. Space was understood

as a given geometric system of organization, a kind of neutral plane with measurable dimensions (Kitchin and Dodge, 2011). According to this rather positivist approach, phenomena could be scientifically observed, measured and analyzed in a quantitative manner, exactly because they were unfolding in such an inert, naturally given space.

No sooner than the 1970s would the credibility of an absolute ontology of space be doubted. Demands for more relational ontologies arose, accusing the dominant approach as reductionist, because it stripped phenomena from social and political meaning. Advocates of a relational ontology of space argued that space was in fact far from a given, passive container in which life took place. Instead, space was conceived to be actively shaping social and economic life and being shaped by these relations in return (Kitchin and Dodge, 2011, p. 67). At this point, it was acknowledged that spaces are not made only of their physical form, but they are equally constituted and managed by immaterial situations introduced by people.

Notably, the aforementioned ontologies failed to consider the dimension of time as part of the equation. Even if the relational conception of space took immaterial parameters into consideration, space and time remained two separate, parallel entities.

Towards the end of the 20th century, some postmodern interpretations of time and space emerged and established new entry points to the discussion. Various scholars pointed out that time and space undergo a process of compression (Harvey 1989), destabilization (Hayles, 2012) or even implosion (McLuhan, 1964). This major blurring of boundaries is triggered by various socio-economic and technological factors that infuse space with temporal properties. As satellites allow for the tracking of bodies and commodities around the globe in real-time and communication networks channel the dispersion and consumption of information in unprecedented speeds, time and space are overlapping – or, to put it more gingerly in the words of Mitchell and Hansen (2010, 111), “they are being sutured together, rendering Einstein’s space-time continuum an everyday life condition”. The diffusion of information and communication networks on a global scale demanded a redefinition of temporality and spatiality.

The above theories prepared the ground for a different kind of ontology that focuses not on what space is, but on how space comes to being. Theorists of this ontogenetic approach understand space as an entity that is not fixed in time, definable or predetermined. Rather, space is perpetually being produced as an assemblage of material and social aspects. As Kitchin and Dodge (2011, p. 68) frame it, space “emerges as a process of ontogenesis”. The idea of process is important, as it introduces the element of time, which was not strongly pronounced in the evolution of spatial thinking up to this point. With time as the key factor of its ongoing practice, space comprises physical aspects (its form and materials), functional aspects (uses and activities like interactions, transactions, mobilities) and meaning (as assigned by context, events and people’s memories, moods, intent).

Notably, another concept of contemporary physics that recently made its way into spatial theory: ‘dark matter’ attempts to explain the phenomenon of ‘gravitational lensing’. In the theory of general relativity, the presence of matter curves spacetime, causing the path of a light ray to be deflected (Cohn, 2010). In the universe, it is the presence of dark matter that is thought to bend the travelling light of galaxies. Scientists can’t actually see it, but its implications on the physical world are a firm proof of its existence. Many see the concept of dark matter as a fruitful metaphor for the hidden environmental processes that shape space, be it urban or domestic. Vanstiphout (2011) uses the term to refer to the complex underlying web of politics, power, economics and society that enacts urban space. “Dark matter is the substrate that produces” as Hill (2012) puts it, referring to policies, market mechanisms, legislation, finance models, governance structures, local culture and national identity to name but a few. In the context of this essay, communication networks and software do participate actively in that ‘spatial’ black matter: they are almost imperceptible, yet they shape space in a set of tangible ways.

3 | (CODED) SPACE AS A MEDIUM

3.1 THE ANALOG ORIGINS

The story of code and space is no novelty – it roots back to the interplay of architecture and media, with communication being their binding substance. As demonstrated in the first part of this essay, space

(and thus, the build environment) was once considered to be an idle, passive container of life. Nowadays, especially when examined from the standpoint of media or system theory, architecture emerges not only as a medium, but possibly as the impurest medium of all (Mitchell 2007, p. 398), since it embodies all arts into a total work of art, a 'Gesamtkunstwerk'. In this light, space is understood as an assemblage of analog media, regaining part of its missing temporality: it includes aspects of the environment (light, shadow, sound, scent and other elements of nature), material properties (texture, color, malleability) and of course boundaries (borders, thresholds and other architectural elements). Space is no longer considered to be idle and mute – it processes and produces meaning through means of structures, signs, ephemeral configurations, spontaneous events and other phenomena. In short, being a spatial discipline, architecture renders itself a form of media – or, as the wordplay goes, 'form informs'.

If architecture is in fact such a diverse medium, why does it fail to convey it? One possible explanation could be that whatever meaning the built environment may communicate, it will end up being mistaken as noise in a superabundant field of signals. This is above all a matter of attention, for as Benjamin (1936, p. 40) insightfully said, architecture is always perceived "in a state of distraction", much like a mundane backdrop to the rush of everyday life. Secondly, it may also be a matter of form. As Jacob (2012) writes, architecture, just as McLuhan's light bulb, emits information – but we fail to recognize it as such because of the way it presents its data. In this case, the Achilles' heel of architecture is that it undoubtedly belongs to the realm of the real, whereas the rest of media reveal the content of contiguous worlds. Also, a third issue of speed arises. Because of its nature, architecture has slow reflexes to paradigm shifts and ever-changing demands. A reason why "architecture is too slow to solve problems" (Price, 2003, p. 57) might be that as a spatial practice, it cannot cope with the speed of a reality that is constantly stretching the dimension of time.

However, apart from architecture's innate mediality, its ongoing mediatization is also reaching a peak. The origins of this phenomenon may be traced back to utopias of liberating actual architectural elements from their functional role, in order to use them as means of communication – for example, the wall shed its role as a load-bearing partition, and instead act as "a mediatic channel of information" between the interior and the exterior (Siegert, 2013, p. 24). The transformation was mostly fueled by the introduction of mass media in the modern household, which penetrated its private space with dashes of public life through devices such as the landline phone, the radio and television. For many visionaries, such as Price and Archigram, this intrusion kindled further explorations of the ways communication technologies enact space, as well as demands for an architecture more ambiguous and ephemeral, able to be adapted to the everchanging needs of its users. As opposed to the restrictions of the top-down modernist approach, the central concept of the 'non-plan movement' came to be that of indeterminacy or calculated uncertainty (Mathews, 2007). Looking back, the founder of the Archizoom explains that "the ingredients of a new architecture had to be technology, software, irony and happiness" (Branzi, 2006).

Early speculations on the spatial productivity of communication technologies became a global reality with the democratization of the mobile phone. Mobile telecommunication dissolved geopolitical borders and time zones across the world further, intertwining space and time closer together. On a personal scale, mobile phones arguably blurred the boundary between professional and domestic space. They prepared the ground for the commonly accepted convention that everyone is available almost anytime, extending working hours beyond 9-5 and into the personal sphere. On the other hand, the mobile phone in and of itself can be considered as a spatial instrument at-hand. A simple phone call between two people constructs personal subspaces entirely dependent on the device and perceivable only by the participants themselves. Fujimoto illustrates the two sides of the coin rather playfully:

> *"Imagine Hegel, Marx and McLuhan encountering the keitai [mobile phone] of the twenty-first century. Georg Hegel is astonished at seeing the spirit of the era dwelling persistently in our palms. Karl Marx complains that it is an alienating fetish object. Marshall McLuhan, his eyes sparkling, chimes in that it will turn the whole world into a village — no, a house.*

> *But in the next moment, he comes upon a realization that appalls him. 'But wait!' he exclaims. 'My wife and children will have the equivalent of a private room with a twenty-four-hour doorway to the outside world, fully equipped with a TV, a bed, and even a bathroom. Where would my place be in such a house?'"* (Fujimoto, 2006)

Telling of the pace of change is the fact that, only a year after Fujimoto conceived the above fictional encounter, the first iPhone was released and reinvented the concept of the mobile phone altogether. Those digital media pocket-knives are not merely enablers of a real-time virtual interconnectivity. Smartphones, more than their predecessors, are vehicles of a selective relative disconnection of the user from his or her physical environment, allowing for the immersion in a personal time-space 'bubble' on one's own terms. Much like Banham's bubble, where domestic devices were home (Banham 1965) yet, in this case, a 'home' that is portable and completely dematerialized subspace.

Needless to say, the transition from the analog electronics of modernity to the contemporary digital technologies and their implications on space – be it urban or domestic – is a fascinating non-linear journey. For the purposes of this essay though, only the contemporary condition will be further developed.

3.1 THE NATURE OF CODE / SPACES

> *"The modern city exists as a haze of software instructions. Nearly every urban practice is mediated by code."* (Amin and Thrift, 2002, p. 125)

As information and communication technologies become the lifeblood of the city, software leaves the confinement of our personal computers to inhabit our surroundings. Moving away from the sterile scenario of u-cities (u- stands for 'ubiquitous' computing) that were built from the ground up in cocoons of big data, code nowadays is developed in synergy with space and vice-versa. It might run on the background of our perception, but it produces tangible effects in physical space. Code assumes an expanding architectural relevance.

The spatial results of software can be addressed according to four successive levels of coded activity, deriving from either coded objects or infrastructures, processes and assemblages (Kitchin and Dodge, 2001, p. 5). Coded objects rely on software to perform as intended, but their agency varies. They range from items entirely dependent on external computers to function (such as CDs or credit cards) to objects that have the built-in ability to take input from their surroundings and possibly connect themselves to networks (such as mobile devices) to pass data on. Networks comprised by coded objects are considered coded infrastructures, but this term also includes all material infrastructures managed by software. As far as urban space is concerned, these could be computing networks, utility networks (like water and electricity), communication networks (like the telephone and the radio), transportation networks, financial networks and so on. Their spatiality resides in the extent of their coverage, from localized to global. For instance, a common localized urban infrastructure is the traffic regulation system: a network, the coded objects of which are the city's traffic lights.

The last two levels of activity are particularly interesting because, unlike coded infrastructures and their objects, coded processes and assemblages do not manifest their presence in some direct material way, yet their impact affects urban space in a broader sense. Coded processes can be better understood as flows of captured data that travel through coded infrastructures (Kitchin and Dodge, 2011, p. 6). They are usually associated with databases of personal accounts (such as banking or healthcare) and they regulate the ways individuals access and manage them. As a result, fundamental urban activities such as commercial transactions and civic services are nowadays almost entirely carried out through coded processes. Lastly, the folding of multiple coded processes and their infrastructures results in coded assemblages of higher complexity. This convergence produces the practices and experiences of particular urban environments, like a hospital, a supermarket or even the transport system of an entire city. Air travel is considered to be one of the most intensified examples of coded assemblages. The apparatus of travelling or transporting goods as affordably and fast as possible is nowadays almost entirely virtualized – from ticketing to boarding, contemporary airports are spaces produced by software (Kitchin and Dodge, 2011, p. 137).

Furthermore, code produces space through a process that is a negotiated and prone to human interferences. This condition echoes the

contemporary ontogenetic approach to space mentioned earlier in this essay. Lefebvre's oft-cited quote, that "(social) space is a (social) product" (1974, p. 26) is very relevant today in a whole new manner. One may suggest that it is the use of brackets that makes room for all the diverse factors that participate in spatial production – code being a new addition to them. In this framework, the alliance of code and space needs "to be understood ontogenetically, that is, as something continually brought into being through specific practices that alter the conditions under which space itself is produced" (Shepard, 2011, p. 23). To describe the hybridization of space and code, Kitchin and Dodge coined the term 'code/space'. They acknowledge the ontogenetic perspective and suggest that code/space, like all space, becomes. The difference here lies in the fact that code quite literally mediates the practices and processes of space production, in a closely interdependent manner.

4 | TOWARDS A (NEW) SMART URBANISM

4.1 FIRST ACT: THE 'SMART' MANDATE

> *"At stake is how the destabilization of time and space by data-intensive environments will be interpreted and employed; as time and space become more malleable, will this flexibility be used to amplify human life, or to drive humanity closer to thinghood*?" (Hayles, 2012, p. 521)

Over the past decade, the discussion on the alliance of urbanism and computation was developed and promoted along the key term smart city. According to the dominant narrative, a city will become smart - mostly energy efficient and sustainable – the moment its urban processes get monitored, optimized and automated by software. However, when these ambitious ideas were put into practice in prototype u-cities, they were met with acute criticism.

Most of these initial smart cities were modelled as centralized control systems, adopting an instrumental approach to urban processes and infrastructures that did not account for unquantifiable aspects of urban life. It seemed that somewhere along the road, smart urbanism abided by global corporate interests, paying no particular attention to socio-cultural contexts and their communities. In the pretext of efficiency, citizens ended up being treated as mere data mines, triggering privacy concerns. Recalling her research visit in Songdo in South Korea, Halpern writes on its absence of spatial qualities:

> *"What is noticeable is the pure aesthetics of computation. […] This is the territory of nonarchitecture. The location of the city, the site, is unimportant. It is hard to know what is being marketed, except some concept of greenness and the fluidity of life as rendered by a computer. […] engineers confess that they have little interest or concern with the spatial form"* (Halpern, 2014, p. 239)

It becomes clear that the stakes are too high to allow smart cities to be thought as urban-scale commodities. If anything, early examples of smart cities such as Masdar in the United Arab Emirates, both underpopulated and dreary, serve as constructive case studies to question what smart urbanism should stand for.

4.2 SECOND ACT: WHAT SMART CITIES (COULD HAVE) LEARNED FROM CYBERNETICS

Soon after corporate visions collapsed on their own claims, many scholars shifted their focus on more holistic approaches to 'city-smartness' in order to address the diverse needs of the world's real cities. Smart cities were redefined as places where "information technology is combined with infrastructure, architecture, everyday objects, and even our bodies to address social, economic, and environmental problems" (Townsend, 2013, p. 15). In other words, they should accommodate both utilitarian needs for efficiency, safety and sustainability, as well as desires for sociability, inclusivity and serendipity.

Despite the fact that such urban futures are currently widely accepted, opinions on how cities should strive for them vary. What kind of a design process could produce such a thorough, yet flexible urban assemblage? What would its collaborative platform look like? More importantly, who gets involved?

Nowadays, architecture is more than ever a site of interdisciplinary convergence. To keep up, architects need to understand and engage with fields such as networks and system theory, interface and interaction design, computing and data structures. Hence, architects and urbanists should be working closely together, not only with engineers, sociologists, geographers, lawmakers and communities (as they hopefully already do), but also with software

developers, data scientists, designers and artists. Thus, a dynamic cluster of spatial practitioners emerges to address fundamental questions under a new light: How is space produced and lived, but also controlled and appropriated? How does it relate to society, politics and time?

In accordance with the ontogenetic paradigm, the production of space is a shared enterprise that asks not only for transdisciplinary expertise, but also for a close collaboration of governmental, administrative and institutional agents, as well as citizens. Now, supposing that all stakeholders are eager to cooperate towards a compromised sum of all vested interests involved, then the challenge of smart cities can be arguably summarized as to how such a field of opposing interests could be managed efficiently, and by whom.

In the meantime, a radical change in the role of the architectural profession took place. The increasing complexity of an urban fabric woven with global networks had exposed how miniscule of an impact a building actually makes within a context of constant flux. Yet, the moment the architectural profession realized that its enduring purpose – the design of the building as an object – was no longer as relevant or meaningful, the role of the architect gained a different kind of significance. This unexpected shift was originally identified by the cybernetic theory of architecture (Pask, 1969) that understood the building as part of a dynamic environment in need of coordination. In fact, the prefix cyber- derives from the Greek verb "κυβερνώ" (kyvernó), which means 'to navigate' or 'govern' a field of possibilities. Thus, architects had been assigned a whole new purpose: to design the larger system itself – one of mutualism between structures and men and with built-in evolutionary properties.

Not surprisingly, the management of a decision-making process that involves numerous stakeholders and seeks to somehow accommodate their opposing interests in a satisfactory and efficient manner seems almost impossible to accomplish. However, it seems that concepts from cybernetics, or the "new science of effective organization" (Beer, 1974, p. 19) might be of some assistance. Would it be possible to construct a model of the city, where the wishes of people and institutions involved would constitute the system-generated variety? Then, the program would analyze the variables and attenuate their variety according to the identified patterns. Given the fact that the system parameters would be monitored in real-time, then the model would always be able to compute optimal actions according to built-in constants.

To test his ambitious hypothesis, Beer designed and constructed a model of Chile's economy, known as Project Cybersyn. Although it never operated due to the coup d'état that destabilized the country, Cybersyn was one of the first data-based control rooms for collaborative decision-making. Faithful to its socialist ideals, it would have brought government officials and the people together within the same space. In Beer's words:

> *"We were teaching the workers, for whom this offering of science to the people was created, how to use the most advanced tools yet designed for national economic management. They could sit with their ministers in the economic operations room in Santiago, watching the animated screens, and discussing the alerting signals provided daily by that clever computer program. They had buttons in the arms of their chairs, so that they could command the appearance on other screens of supporting data […]"* (Beer, 1974, p. 47)

Beer's influential vision set the example for the most common of smart interfaces: the dashboard (Mattern, 2015). It is worth noting that, even if Cybersyn had considerable weaknesses, most of its predecessors did not even share its justified concerns about transparency, participation or education of the wider public, replicating Songdo's control room of uncanny 24/7 CCTV footage displays (Lui, 2014). On the other hand, there are some noteworthy exceptions, such as the Dublin Dashboard, which itself "emerged through design, tinkering, debate and negotiation" (Kitchin et al., 2016, pp. 28-29).

In this ongoing process of refining 'smartness', the concept of indeterminacy makes a return. Smart cities should allow for "spontaneity, serendipity and sociability" (Townsend, 2013, p. 15), because if all randomness is programmed out of the equation, cities will turn into sterilized, homogenous environments of automation. For instance, with reference to the decentralized and almost completely autonomous traffic-control system of Japanese trains – on which the Korean 'smart' ones are based (Halpern, 2014, p. 276) – anthropologist Fisch explains:

> *"The margin of indeterminacy is the space and time of the human and machine interface. Put differently, it is the dimension in which bodies and machines […] intersect with the time and space of institutionalized regularities to produce a metastable techno-social environment of everyday urban life"* (Fisch, 2013)

In short, even if urban life seems to be in an apparent state of equilibrium, it is always a synthesis of smaller, unpredictable situated processes and events – and this is exactly the reason why a margin of indeterminacy is of vital importance to the productive complexity of the smart city. In a similar manner, the cybernetic vision of an architectural system runs on the concept of 'underspecification'. According to Pask, the architect should abstain from predetermining any goals for the system. Rather, what an environment needs to be reactive to the needs of its users is only a set of constraints (Pask 1969, p. 75). Thus, the architect becomes a catalyst, infusing adaptability to systems through a number of evolutionary principles.

4.3 THIRD ACT: PARTICIPATORY AND OPEN - SOURCED

Over the last few years, confronted with centralized narratives of 'smartness', a growing number of scholars started criticizing the epistemologies and political ideologies behind them by exposing their technology-driven, managerial approach to civic rights and space making. Differentiating themselves from the prevalent goalsetting of automation, optimization and efficiency, these alternate visions seek to build and expand on fundamental civic concepts, such as ownership, participation and citizenship through the curated employment of digital technologies from the bottom-up.

For instance, by taking ownership as the point of departure, and removing its traditional content of property possession, it can then be assigned to city commons and redefined as a strong sense of responsibility and active engagement. In this light, the concept of ownership emerges as an unexpected tool of productive coexistence between stakeholders of different backgrounds and possibly conflicting interests (De Lange and De Waal, 2013). Once more, digital media play an important role in empowering participation in decision-making, thus reinforcing a sense of place and timing amongst the community as soon as shared issues arise. Examples vary in scale – from cases as ambitious as crowdfunding the development of brownfields into social hubs, or sensing environmental pollution to demand stricter regulations, to others as habitual as car-sharing.

It becomes apparent that tactical interventions performed by networked communities infuse the ontogenetic production of space with temporal qualities. Notably, their ad-hoc response to enduring shared problems is primarily channeled towards ephemeral events, instead of inducing lasting change. Here, the agents aim to create spontaneous situations and transient experiences rather than spaces - an aspiration embodied in Cedric Price's 'Fun Palace'.

On the other hand, *appropriation* is the act of assigning use value to accommodate circumstances, regardless of or contrary to the confines of centrally-designated uses. Notably, Lefebvre clarifies that the nature of appropriation is less so spontaneous or 'pop-up'. Rather, it takes time and presupposes a certain degree of strategy and intent (Kofman and Lebas 1996, 18-31).

At this point, it is useful to consider the notion of *engagement*, which regards participation and appropriation as constituent of the right to the city (Lefebvre, 1996, p. 174). When it comes to resources, participation is arguably less demanding than appropriation. For instance, with the proliferation of online participation platforms and locative mobile media, the citizen is always equipped with a convenient, direct digital toolbox of participation. However, some scholars warn that this effortlessness is not entirely benign. There is a considerable risk of reducing citizenship to a passive behavior pattern (Gabrys, 2014) and thus diminishing the citizens' agency in the decision-making process.

It would not be an exaggeration to say that such dilemmas seem to reside in the genes of the smart city paradigm. To transcend them, Fuller and Haque turn once more to code to unravel another type of architectural relevance. They speculate on the potential of space-making inspired by the politics of open-source software. Their proposal is a set of two parts. First, the 'spatial operating system' is basically a coded infrastructural framework within which "people can configure and reconfigure their own environments" (Fuller and Haque, 2008, p. 18). Secondly, this is coupled by a 'concurrent versioning

system', which would be a dynamic tree-structured archive documenting space in progress. 'Urban Versioning System 1.0' conceives space as a dynamic social environment, emergent from the citizen's collaborative efforts, allowing for experimentation, evaluation and inhabitation along the way. Here, being a shared enterprise, space becomes through an open spatial process with no predefined ends.

While speculation on smart futures and potential strategies continues, cities have already been sewn with code. The substrate of smartness is in place - and it is set by the relationship of space and code.

5 | CONCLUSION

In recent years, the need for other ways of enacting spatial change challenged architects to operate beyond their traditional responsibilities. The game of space is nowadays more interdisciplinary than ever, with an emergent cluster of spatial practitioners shaping its futures and posing pressing questions that are yet to be answered. This essay sought to study the ongoing hybridization of code and space, drawing diagonals between its possible origins, context and implications.

A timeline of the ways in which the conversation on space took an ontogenetic turn served as a departure point to focus on its background processes and immaterial aspects. Subsequently, with the consideration of architecture as a medium, the thread connecting its inherent mediality to its further mediatization was explored, which arguably prepared the ground for the hybrid of code/space. Afterwards, typologies of code/spaces were analyzed to demonstrate their potent influence on social and economic aspects of our everyday life. In support of this argument, several examples were provided on how code transduces space.

Also, this work sought to map the ongoing discussion on smart urbanism in three suggestive clusters. After a brief account of the smart-city paradigm as initially envisioned, it was deemed useful to consider the enduring 'smart' relevance of cybernetics. These lessons may prove invaluable in understanding and handling the complexities of space making. Nonetheless, to claim that the smart-cities paradigm disregarded cybernetic theories would be indicative of a certain naiveté. Ironically enough, smart cities adopted the most managerial and centralized of cybernetic aspects, ignoring crucial control 'reliefs' such as evolutionary parameters, the margin of indeterminacy or underspecified goalsetting. Instead, other ideas such as the predictability of the system (Pask 1969) were stretched out of context, in an attempt to control the very nature of space. Messy and inconsistent as it is, the smart mandate demanded that urban space gets rationalized by not accounting for the variety that nurtures sociability and liveliness.

Of course, that does not mean that cyberneticians managed to decode the essence of cities. In retrospect, their weaknesses become apparent. For instance, even if cybernetics reinvented the role of the architect, distributing the authorship of space to the system, it is clear that the architect remains the sole system designer. Citizens involved may enjoy the degree of freedom the system allows for, but they cannot change the rules of the game. Also, the evolutionary principles of cybernetic systems were hardcoded or built-in. Evolution was only possible within the framework devised by the architect.

Addressing the above issues, the third smart urbanism cluster gathers ideas that have emerged only recently in the field. Moving towards more open-sourced and participatory paradigms, fundamental civic concepts and the role of the architect change once more. With architects no longer being the sole authors of space, could decision-making be diffused through a distributed network to engage a larger body of decision-makers? As new models rooted in the common ground of code and space develop, the architect's purpose is that of a mediator or a catalyst. Acting as self-driven agents, architects should be tuned with societal needs and attempt to organize citizens whenever shared issues emerge through open-sourced, participatory platforms for action. Meanwhile, as citizens develop fluency in appropriating space, the new paradigm of smart cities moves away from the initial vision of heavily data-driven, high-tech large infrastructures of u-cities. Instead, the focus is directed toward 'soft', situated interventions in the urban fabric of existing cities.

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