Perspectives on ubiquitous computing

Perspectivas sobre la computación ubicua

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ABSTRACT

This paper presents three analytical perspectives on the relationship between ubiquitous computing (ubicomp) and various social and cultural dimensions. To achieve such aim, the study reconstructs the last three decades of theoretical production on the subject. Firstly, the paper analyzes instrumentalist positions about the impact, application and adoption of these developments in different areas as well as the trends that reveal their complexity. Then, in a second section, attention is turned to the ethical dilemmas and cultural criticisms that arise before pervasive computing. Thirdly, the study focuses on the political tendencies that emerge over ubicomp. Finally, conclusions about the potential of thinking these perspectives as a whole are drawn.

RESUMEN

*Este artículo presenta tres perspectivas analíticas sobre la relación entre computación ubicua (*ubicomp*) y diversas dimensiones sociales y culturales. Para ello, se reconstruyen las últimas tres décadas de producción teórica sobre el tema. En el primer apartado se analizan posiciones instrumentalistas que examinan el impacto, la aplicación y la adopción de estos desarrollos en distintas áreas, así como las tendencias que descubren su complejidad. Posteriormente, en una segunda sección se indagan los dilemas éticos y las críticas culturales que surgen ante la omnipresencia de la informática (*pervasive computing*). En tercer lugar se estudian las tendencias políticas que emergen ante la* ubicomp. *Por último, se recuperan las potencialidades abiertas al pensar estas perspectivas en conjunto.*

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Introduction

Since the end of the 2000s, mining and intensive calculation of large data brought new economic and technocratic hopes together in the face of the capitalist crisis; notwithstanding, the roots of these strategies are to be sought for, at least, a decade before the beginning of our century. By the beginning of 1990, a research, development and innovation program that would drive the technological change rooted in the epistemic background of contemporary societies took place (Rossi, 2018a; Godin, 2017). This program adopted a number of names: penetrating, omnipresent and generalized (pervasive) IT, intelligent environments, proactive, collective, cloud computing and, maybe, the most recurrent name: ubiquitous computing (*ubicomp*).

In spite of the protean variety, most of the research lines in the program have recorded certain heritage in the works of Mark Weiser. The head of engineers of Xerox Parc is usually recognized because, between 1989 and 1994, he wrote a series of documents to advance several aspects of *ubicomp*. His most quoted study starts with a famous statement: "the most profound technologies are those that disappear […] and that weave themselves into the fabric of everyday life until they are indistinguishable from it" (Weiser, 1991, p. 94).

In this article, Weiser would mirror ubiquity on the model of scriptural devices but only to outweigh them towards computer processes that would not assume man-machine interactive interfaces. At the same time, against the promise of cyberspace reality, Weiser pressed for an embodied virtuality that would multiply computers in our world before having to adapt to the computational universe. Therefore, dissemination of IT would be fostered at a variable scale (inch, foot and yard), making emphasis on mobility and contextual attention –always within the framework of restrictions of a limited connectivity– (Krumm, 2016). Specifically, Weiser would center his discussions on the imperceptible, calm and invisible nature of developments that would be embedded in the tasks without standing out because of their technological features, underscoring that this would be a third wave of IT development that would subsume, without superseding, the previous paradigms of mainstream and personal computing.

Until the mid-1990s, the term *ubicomp* was mainly related with the information of work environments (Ronzani, 2009). Nonetheless, dispersion of microchips, processors and terminals rapidly exceeded in the environment of offices and penetrated into spheres like home and leisure. These would be the explored ways behind the projects of pervasive computing. From IBM's factories the position of Weiser would be carried to an extreme, but seeking to become different by remarking the centrality of networks for the post-PC age, as well as the use of intuitive applications for the solution of daily tasks and networking as an expression of mobility and constant connection –complying with the principle of an omnipresent IT "anytime and anywhere", as desired by Hansmann, one of its promotors (Saha & Mukherjee, 2003).

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According to Dourish & Bell (2011), Intel would also develop its own trend called *proactive computing*, which emphasized connectivity and predictability of data arising from the environment, by articulating an interest in *machine learning*, as well as data processing, algorithmic reticularization and customization of digital experiences. In fact, these emphases may be tracked down to Weiser's idea of invisibility, as presented by Tennenhouse (2000) when defining proactive computation as the overcoming of human-computer interface problems, as a call to initiate intercommunication between computers and their environment that would displace humans from the feedback loop (a company known nowadays as Internet of Things [IOT]).

In a similar sense, the concept of ambient intelligence established at Philips arose to conceptualize technologies that disappear by creating responsive electronic environments and generating the bases of current developments at intelligent households (De Ruyter & Aarts, 2004). Lastly, centrality of the *ubicomp* program would be better reflected on those who would find support in Weiser to sustain evolution towards crowd computing, distributed in the cloud and in a semantic web. According to Abowd (2016), the notion of crowd computing accelerates *ubicomp* by removing the distinction between human and machine and by integrating both processes through connectivity and big data processing. In the most recent stage it is presented as a changing milieu (shroud computing) going through organic, inorganic and cultural strata.

As evident, most of these names come from transnational think tanks[1] and, in spite that, in engineering terms, different emphases have been attempted, they comprise research lines into *ubicomp* which exceed the mere multiplication of artefactual realities to state a mutation in sign regimes and in contemporary materiality by means of extending computing to all the physical, social and mental weaving.

According to Wiegerling, the hard nucleus of the R+D+I program of *ubicomp* supports true visions on encrypted social and cultural practices in the colonization of daily life sets (Greenfield, 2006). No wonder Weiser himself, in his late writings, centralized his ideas with the notion of "post-modern computing" while he fostered incorporation of researches stemming from humanities and social sciences, strategic disciplines to form calm and invisible technologies (Galloway, 2004; Fuller & Ekman, 2013).

Paradoxically, in spite of the declared intention to transform daily life, it has been commonplace to underscore the lack of social and cultural studies aimed to analyze *ubicomp*. However, any approach to academic literature allows us to discover that these affirmations are not completely true. Therefore, the purpose of this article, through a critical hermeneutic analysis of the last three decades of researches on the topic, is to systematize three great prospects with different associated trends, which, in spite of their profound distance, have had the clear intention to link some social, cultural or political dimensions and problems arising from the *ubicomp* program. Without the intention to recover each side and author, we will outline three specific moments: a sort of

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deterministic gaze on the application, adoption and impact which is being surpassed by approximations from the complexity of the design; the openness of ethical dilemmas and critical approaches and, lastly, new political problems arising in *ubicomp*.

Designing *ubicomp*: on the instrumentality of its application to conflicts of complexity

One of the first consequences of the *ubicomp* program, and of its intention to extend to everyday life, was affecting the field of disciplines of the human-computer interactions, driving them to cover every aspect of human life from multiple manners to compute (Rogers, 2012). So, it is not unusual that one of the first perspectives on *ubicomp* comes from design, through an instrumental concept, of social and cultural dimensions, whilst application and impact areas would be receivers of engineering solutions.

Thus, a set of reflections on developments aimed to the assistance application in health areas appear, focused on older adults or disabled persons, and in relation with personal autonomy topics (mobility, memory), follow-up of biological indicators, data processing, domestic attention, emotional control, interpersonal relations, et cetera (Morris, Lundell & Dishman, 2004; Sarivougioukas in Khosrow-Pour, 2018). In a completely strange tone, some assistance technological projects, financed with entrepreneurial funding, will go so far with the intention of fulfilling the needs of the homeless (Le Dantec *et al*., 2011).

The social dimension as an intervening variable will become relevant for these developments with an endless number of studies on surveillance, control and public security devices (emphasized after 9/11), as well as by approaches that will follow the application of *ubicomp* to fitness or to sports (Barkhuss, 2006). Other researches will, additionally, address the analysis of management problems in occupational contexts, as well as on security standards of tasks (Kinder-Kurlanda & Nihan, 2015) and, in abundant rivers of ink, on educational subjects by means of the ubiquitous learning problem. Altogether, this is about the concept of developing *ubicomp* as a problem-solution program in the short term, from technocratic perspectives allegedly cleansed of ambiguity.

However, the favorite field of applications include businesses, commerce and economic development. According to Bohn *et al.* (2005), the use of *ubicomp* for the now economy is encrypted in comprehensive monitoring and data extraction methods on the production, distribution, marketing, sale and consumption. Specifically, two relevant features are at the center of said economic processes: the ability to follow goods and services in real time (tracking, inventory management, et cetera) and the capacity of

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introspection of intelligent objects (information on their production, availability, use, repair, customization, among others).

For this reason, a number of people who will confirm the potential of *ubicomp* to transform static markets into highly dynamic ones (Begole, 2011), as well as to open business models linked to pay-per-use modes (where ownership could be replaced by licensing models) or based on the reliability of the *blockchain* for automatic transfers, searches and virtual tests of products that would allow traditional limits to be redrawn of e-commerce stores (Savastano *et al.* in Khosrow-Pour, 2018). In Latin America these transformations would not stop having influence; in fact, ECLAC members, in their last digital agenda, assert that IOT and ubiquitous computing will have an impact on the new horizon of economic and social development of our region (ECLAC, 2018).

Along with designs that include the social dimension in terms of applications, there are some analyses that have stopped to accept *ubicomp*. Success or failure to adopt mobile technologies based on location and tracking in different social strata has been under study repeatedly (Barkhuus & Dourish, 2004; Yoo & Lyytinen, 2005; Vega & Pau in Khosrow-Pour, 2018; Zeal, Smith & Rens, 2010; Geihs *et al*. 2012).

Notwithstanding, gradually, from the design plan, there have been researches aimed to discard deterministic and instrumentalist positions to highlight complexity. Thus to Dourish & Bell (2011), *ubicomp* is not simply a promise of a distant future, but it already is among us, therefore, we have to pay attention to its effects on a basically disorderly reality (as shown by the infrastructures of daily life –an exacerbated condition in Latin America). Therefore, they will uphold that, in order to understand *ubicomp*, we have to do this not only from the technical ambience but also from the cultural, social, political economic and historic one and, as stated by Crabtree *et al.* (2006), by means of an ethnographic methodology.

In fact, Dourish & Bell (2011) highlight on the fact that, different from what Weiser proposes, it is necessary to recognize cultural variations in relation with technology and to assume the study of negotiations, commitments and resistances of their meaning, specifically stopping in technology as a cultural and social production site. Hence, they uphold that between the technical and socio-cultural sides there is no hiatus, but a complexity to be understood.

In the same sense, Rogers (2006) proposes an alternative agenda for design, stating that we have to move from the mindset which intends to build smart invisible and proactive environments (smart building, smart city) which, in the last term, turn subjects into passive individuals, into environments that would allow them to be more constructive, creative and imaginative in our everyday practices and in our relationships with the world. Therefore, the author makes a stop in how learning, leisure and sanitary

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practices may be improved in the contexts that refuse to respond to instrumental criteria of rationality and predictability.

We can also mention some kind of a social turn which has supported the appearance of other studies and designs that focus on the construction itself of socio-cultural environments from the developments of *ubicomp*. For example, there are analyses that assess the communicative function of these technologies (Vetere, Howard & Gibbs, 2005) while there are systems which allow the construction of ties and to have family and friendly relationships –social computing, as called by Hemmmatazad (in Khosrow-Pour, 2018)–.

These projects make an emphasis on the reading ability of the social context by *ubicomp* (Wang, Bodily & Gupta, 2004) and their role in task coordination and organizational management environments (Jessup & Robey, 2002), as well as the expression of identities and creation of contents (Persson, 2001). Likewise, several different approximations insist that these technologies have to adapt not only to perceptual and human motor limitations but also to the forms themselves where we interact as a group (Grudin, 2002) and to followers who maintain said communications (Broek, 2013).

This has certainly triggered the search of affective computing (Picard, 2000), but also ways to deconstruct *ubicomp* through the trans-individual character of affectivity inscribed in the practices of design (Sengers *et al.*, 2004) or in the problematization itself of *affection* from developments (Schick & Malmborg, 2010).

In a concomitant way, Greenfield (2006) has inquired how the complexity of *ubicomp* is deployed on daily life, breaking tacit agreements at the workplace, at home, in the presentation of self, on the right to privacy, et cetera. In fact, his book calls the *ubicomp* program with the *everyware* neologism, formed by the words *everywhere* and *hard-software*. To the author, *everyware* includes processing gestures, behaviors, objects and surfaces of everyday life ready for the technological intervention; he upholds that it may be understood as the processing of information dissolving in behavior, because "it is not only some kind of *hardware* or *software* but a condition" (Greenfield, 2006, p. 31).

It is an evolving, environmental field which appears in unaccustomed activities for the intervention on information technologies, such as exercise, game, sexuality, friendship or meditation, and which, when mediated by the *everyware* turn into something different. Greenfield will criticize this program, gathering lines of thought which exceed the design and turn it into a problem.

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From different ethical dilemmas to critical thinking about *ubicomp*

In 1991, at the Xerox division of European research, the philosopher B. Anderson, prematurely, upheld the need to explore both social consequences and ethical conflicts arising from *ubicomp*. Therefore, he would engage in criticizing the great moral theories applied to generalized IT, underscoring that a new vision would not be able to separate technologies from their potential use, and that cultural standards that could incorporate these innovations were to be created.

This perspective, pinned to philosophy of the Anglo-Saxon technique, would continue in great nuclei of ethical dilemmas that arose over the past decades related to the *ubicomp*. Among these recurring topics, as shown by Hilty (in Kinder-Kurlanda & Nihan, 2015), there are reflections on the legal and moral responsibility of autonomous computer systems, as well as on the dissipation of accountability.

Merged to said topic, the problems of autonomy and self-determination have often been linked to the risks of environments where there are potential health damages (such as medical diagnosis, assisted surgeries, et cetera), where human life, generally, is at stake (air traffic, commercial and military unmanned vehicles [drones]) or where decisions delegated to data-intensive information technologies may affect the autonomy of humans through infrastructural failures with catastrophic consequences (Mattern, 2005). So, as maintained by Greenfield (2006), *ubicomp* gives rise to circumstances where human agents, judgment and willingness are gradually superseded by algorithmically applied norms and standards.

At this new codification of practices, it is not strange that the topic of responsibility be accompanied by Wienerian ambivalence in respect to human control ability in the face of these autonomous systems (Milner, 2006), at the time the transparency of decision-making systems is threshed. Thus, an automobile in IOT (with hundreds of integrated circuits, GPS, cameras, sensors and others), could no longer be completely loyal to its owners but, for example, to the insurance company, to traffic laws, or to manufacturer's warranty.

Evidently, closer to these ethical problems, discussions on privacy are frequent in relation with data protection, automatic individual characterization without them being aware (RFID, biometric devices, et cetera) and location and positioning systems. In 2008, Zittrain warned us that these allocated networks of sensors created new ways for governing and monitoring citizens (which we will discuss later on).

To Bell *et al.* (2003), counterattacking these problems revolves about the construction of intimacy from the *ubicomp*, both regarding cognitive and emotional closeness (conscious and responsive developments to our intentions and actions), of physical proximity with the body (sensors for portable attire); such as technology that is

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used to express our feelings to others. In the same way, Greenfield has highlighted the fact that the milieu of the *ubicomp* has left the Goffmanian idea with no effect of the different masks behand the presentation of the self, as the *everyware* surfaces signify latent information on our lives, and turn them into dangerously transparent ones.

Lastly, there have been dilemmas on technological paternalism or the imposition of solutions that harm personal autonomy. Above all, in respect of two fields where discussions proliferate: security (biometrical computing) and health (some assistance developments mentioned above). According to Rogers (2006), technological paternalism expresses the trend of *ubicomp* systems to infer and predict the behavior of users through *machine learning*, which gives rise to dependency relations with the usual threat to individual self-determination.

Notwithstanding, in addition to these ethical problems, there is a set of perspectives which carry forward broader cultural criticism (Langheinrich *et al.*, 2002). In the first place, there are questions addressed to the vision of ubiquitous computing, especially its voracious pretense of penetrating to every aspect of existence –in fact, Weiser (1991) himself warned us that in the wrong hands, *ubicomp* could transform into a totalitarian project.

At the same time, our capacity to understand the scope of these phenomena has been questioned, since, if it feasible to note that objects (such as a laptop) are designed, manufactured and commercialized by companies, it is really difficult to know who has designed a situation such as those created by digital platforms (evidently, the fields of human action are exceeded by a disperse, diffusive and complex computer agency, [Greenfield, 2006]). In the same way, another topic for criticism lies on too vague goals of ubiquitous computing as compared to the huge investment efforts needed for the attainment thereof.

In the second place, as mentioned above, there is a set of criticism addressed to the negative effects of ubiquitous computing revolving around the capacity for an efficient and ruthless surveillance that would lead to degradation of privacy (Mattern, 2005). *Ubicomp* has the unprecedented potential of creating monitoring networks, linking private and public life and extending temporarily and spatially tracking abilities (logs, metadata, CCT, et cetera) in what has been conceptualized as exacerbation of panoptism or as an integral part of the existence of new social forms of control (Galič, Timan & Koops, 2017).

Ubicomp supplies a profound capacity of search through a large amount of databases collected in 24/7 systems, as highlighted by Crary (2013). Therefore, Mayer-Schönberger (2007) has stated that, in order to break the inertia of devices that would not stop recording, we have to legislate and codify a sort of programmed oblivion.

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Likewise, other critics make an emphasis on the false promises and expectations of *ubicomp*. When the millennium was starting, Winner (2000) engaged in ubiquitous computing and put across the chimeric need to multiply communication gadgets, on the whole social body. To the renowned philosopher of technique, descriptions of the world in this R+D+I was breathtaking, although they only are for their simplicity, because none of these objects meets the basic standards of usefulness.

Fundamentally, in spite of promises, none of these devices would relieve the effort, save time or reduce the stress, since, to the extent people get more equipment, their lives are not plain but more complicated, demanding and rushed in an endless occupation, as shown in the evaporation of limits between work and leisure. In the same sense, Spigel (2005) has analyzed the trends of home design technologies of smart houses, whose pinnacle is "post-human domesticity" characterized by highlighting domestic subjectivity which reproduces the worst stereotypes of gender and mirror the future over the past.

From phenomenology, Araya (1995) identified the main problem of omnipresent IT and its effects on the relationship between man and the world. To the philosopher, *ubicomp* changes the environment where we live, turning it into a subservient artifact with which propagation of "digital surrogates" result in a transformation, displacement and substitution of their main properties. Otherness is partially eliminated and we are willing to live in a world with no outside.

In fact, the problem with augmented reality systems which depend on *ubicomp* shall be the loss of the likelihood of perceiving the resistance of all *Lebenswelt*, a confrontational character which is vital for the experience of reality (*Wirklichkeit*), as well as for the development of personal identity. While, McCullough (2013) has maintained that the pervasive computing developments have transformed attention processes by exceeding the concentration of GUI. Perspectives, such as those of the authors are accompanied by the appearance of a set of profound phenomenological problems which we will not be able to analyze here (as is the case of M. Hansen's) or the philosophical dimensions which relate omnipresence and ubiquity with magic-religious characteristics of techniques (Adamowsky, 2003).

Ubicomp as the horizon of political thinking

Detached from previous criticism, it can be said that there are political perspectives thinking of *ubicomp*, at least, on three clear trends.[2] First off, there is a liberal, critical thinking that considers that policies are necessary to drive ubiquitous computing and to not sacrifice western democracies in the face of the increasingly bigger power of corporations.

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An example of these trends is the work of Howard (2015), who makes a direct attack to the problems of IOT in a series of artifacts that are not designed, in principle, for deliberate social interaction or the creation of and consumption of contents. It is a more extensive and invasive Internet that is not experienced by GUI (browsers), producing, to the British author, a decline in the awareness of uses on the sensorial power of technologies, which, by 2020, will affect large parts of the world population culturally, economically and politically.

In this scenario, to Howard (2015), companies that maintain our digital networks, the data warehouses, development firms of applications and platforms, advertising agencies and licensees, as well as social media companies, access our data and interfere with the flow of information. Notwithstanding, their ends are obscure to users, hence, to the author, we have to make decisions on the IOT policy and its connectivity infrastructure, for, as shown by its history, Internet may be used for censorship and surveillance or for opening closed societies and breaking up authoritarian regimes.

Howard has baptized this new period of the global political life as *Pax technica*, a term which, far from the idea of peace, expresses stability and predictability of global political machinations arising from covenants that are still more assiduous, among large technological companies and governments. In this *Pax technica*, democracies incorporate amazing social control levels through the political and corporate datamining, digital censorship, online surveillance, etcetera. However, to Howard (2015), governments shall have less possibilities to govern IOT and to turn each device into a valuable political data provider.

Against this, the author proposes that the Internet of Things ought to enable 10% of its capacity to be used with a civic sense and in the best interest of the common good (by public health organizations, libraries, non-profit associations, academies, among others). He is also planning that his power ought to be available to natural disasters or to foster philanthropy, at the time data produced by these systems should be openly shared by the companies concentrating them. He explains that people ought to be able to decide whether their data shall be available or whether they could be commercialized. Lastly, laws ought to be passed against mining concentration, data collection and analysis, and any artifact should be explicit as to who will be the final beneficiary.

Secondly, analyses have emerged that come from the political economy of communication and its alliance with cultural studies, from where there have been fundamental texts to understand how computing ubiquity is in alliance with monopoly, military and commercializing trends of daily life. Indeed, in the center of this analysis is the discussion on the scopes of contemporary capitalism, as well as their relationship with democracies (without making them equivalent).

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To McChesney (2013) democratic forces ought to make Internet to stop the trends fostering inequality, monopoly, hyper-commercialism, corruption, stagnation and depoliticizing, but to do this it should be understood how digital networks are in the center of contemporary economy.

Morozov's (2016) contributions are presented in a similar direction, who strongly criticizes the multiplication of sensors and connectivity which turn citizens' information into merchandise as their self-surveillance is monetized (encrypted in the free but under surveillance mail, as well as in zero-price apps, but financed by advertising). In fact, to the Belarusian author, "digitalization of daily life and eagerness of finances run the risk of transforming everything –from the genetic code to our bedrooms– in productive values" (Morozov, 2016, p. 264). Notwithstanding, the researcher has traced some equivalences between the neoliberal discourse and the understanding of technology that will not be upheld in the third political trend on the *ubicomp*.

In this trend, Mosco (2017) has analyzed the Next Internet phenomenon as the set which articulates the technical power among cloud computing, big data and IOT. In these ubiquitous networks, while cloud computing supplies essential storage and processing, large massive data provide new opportunities to add value to stored information and the Internet of Things collects mountains of data for analysis. In fact, computer ubiquity assumes automation and integration of these three systems which, clearly, depend on telecommunications.

To Mosco, the fact that it becomes more difficult to determine what a computer is and is not –for they are everywhere and, at the same time, disappear; they are nowhere)– makes ubiquity a vital characteristic to distinguish the Internet which we know nowadays of future developments. Here, people shall have a tendency to decline control in favor of algorithmic processes upon which they shall trust to make business, government and daily life decisions. Specifically, Mosco's (2017) argument is that, under this tripod of Next Internet, there are growingly integrated systems that accelerate the demise of a democratic, decentralized and open-source Internet.

In the same vein, Srnicek (2017) warns about the emergence of oligopolies and monopolies behind a new platform capitalism. To Mosco (2017) and Srnicek (2017) these platforms, of predominant US capitals,[3] have reached control levels that make free competition difficult, causing inequality to grow. The underlying diagnosis is that, currently, these ubiquity trends are being used, primarily, to expand commodification and militarization of the world, a road which is not unavoidable but which needs political interventions to be reversed.

In addition to studying geopolitics of the Big Five (Google, Facebook, Amazon, Microsoft and Apple), Mosco (2017) stops in cultural transformations tracing every dimension he deems necessary for the production of meaning (work, language,

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education, myths). Therefore, in particular and in respect to the work, like Fuchs (2014), Cardon & Casilli (2015), Dyer-Witheford (2015), Mosco (2017) has not stopped stating the tandem among digital labor, precariousness and flexibility.

This problematic nucleus of labor conditions in *ubicomp* has been the center of attention to authors who study the power of these developments with the purpose of achieving close surveillance in the workplace, as well as exacerbation of the elimination of the limits between private and professional life (Zittrain, 2008). The thing is that, in general terms, from the Italian post-workerism and from the topic of cognitive capitalism, authors like Lazzarato (2014), Vercellone (2011) and others seem to assume, behind the extension of the recovery of equity to all the social body, which is the omnipresence of IT is linked to automation processes of daily life in the neoliberal horizon – arrangements of social formations of control that configure new subjectivation processes (*cfr.* Rossi, 2018a).

Against these trends, Mosco's alternatives insist on the need for a political strategy with a vision to support democracy and public control, and which strive to refer to users as digital citizens rather than mere consumers and points for the production of data and metadata. Thus, political options are to be built around lines of action that revolve around the occupation of Next Internet for social movements, marketing regulation, and resistance to militarism, restoring privacy, as well as striving for a universal basic income as a human right (in the face of the impact of labor automation).

At the same time, Mosco underscores the need for greater control of electronic pollution because these lines of political economy allow us to see that, in spite of the high power of dematerialization, a predicate of generalized and omnipresent IT, instead of generating new opportunities for sustainable development, growing ecologic threats have been configured (Zittrain, 2008).[4]

In the third place, a set of political trends have arisen which mainly emerge from the inheritance of the French post-structuralist criticism. At the center of these contributions, the political question gathers techno-genetic, epistemo-genetic and onto-genetic dimensions to outline an original gaze on the ubiquity of networks and digital objects.

Specifically, inspired by the work of Simondon, Hui (2017) has stated that questioning our digital milieu is paramount to understand the immediate political destiny. Therefore, he analyzes the concentration process of *ubicomp* or, in other terms, how we have moved from one age of hypertext (where online objects were significant only to humans) to the age of semantic web (where they also become valuable to machines represented by the knowledge on AI). The answer is found in individualization (or grammatization) of the genesis of markup languages (from GML to XML, with HTML forming a less concrete level) and in their description (in web ontologies) in

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related terms, which provide new materiality emerging from the associated media consisting of protocols, databases and algorithms.

But, in addition, the Chinese philosopher assumes that living psychic-collectives tend to turn themselves into digital objects. However, Hui (2017) does not develop this edge as is done by other authors who recover what could be considered as the return of the effects of individualization and the associated media of digital objects on the cultural and psycho-social world. This was what Simondon had in mind when he considered a sort of restructuring of the media (first-off geographical and then cultural) from networks (or sets) of information, communication and transport (*cfr*. Rossi, 2018b). Hence, authors such as Mills (2016), from the project of a Simondonian theory of the New Media, states that ubiquity of digital technologies leads to the emergence of techno-cultural media where software connects orders of different magnitudes (such as traders and high speed of market economy) affecting psycho-social individualization.

Recognizing the existence of this milieu or intermediate reflects that the nucleus of the *ubicomp* program, aimed to start a seamless computing, with no cracks, continual, smooth, infrastructural, constant and without interruptions (or as suggested by Weiser, seamless or smooth), has been achieved (Mainwaring, Chang & Anderson, 2004). This configures a naturalization of encrypted ubiquitous computing in the complexity of intensive information intelligent ambiences.

Consequently, it is not strange that this problem is in the thought of authors such as Ekman & Diaz (2016), who consider *ubicomp* as a way of inculturation. To these authors, the *ubicomp* culture implies reticular computational entities which are co-individualized by network systems under context awareness techniques, of temporary anticipation, of autonomous agency, et cetera. A true wrapping in permanent variation which has allowed Abowd (2016) to disseminate the idea of shroud computing –whose paradoxical and alarming translation would be computational shroud.

A reference to all the authors named here is the French philosopher Stiegler (2015) to whom, inspired by the Deleuze-Guattari's *dividual* category and in the Simondonian alienation category, new digital milieu forge processes of *deindividualization* or *proletarianization* of control societies (*cfr*. Rossi, 2018a-c). According to Stiegler (2015), significations (images, symbols, et cetera) have the condition of being supported by technical realities and enable the foundation of psychic and collective individuations. This is the case of technical realities that retain temporary structures and make them spatial (or grammatized) beginning with the same writing (hence, they are platonically called *hypomnémata* and *phármaka*).

Notwithstanding, to Stiegler (2015) digital techniques of *ubicomp* design a critical moment as they are recovered by the dynamics of contemporary capitalism. Mnemonic or tertiary retentions breed a third stage in the encrypted proletarianization in

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the progressive destruction of attentional processes, the breakdown of resources of criticism in favor of predictability and anticipations on the spheres of knowledge (to do, to live and theoretical).

In other terms, a generalized proletarianization which not only dares to be mounted on the expropriation or alienation of our gestures and likes (as was done by the programmed cultural industry), but which also is deployed on the thought, theorization and imagination (noetic faculties). Roucroy & Berns (2016) refer to this as algorithmic governmentality, while correlations of high-speed large databases, varieties and volumes (asignifying semiotics to Guattari [2003]), mobilized through collection, analysis and profiling strategies that assure neutralization of the main characteristic of the realism relations. That is to say, they make the encounter of potentials or the likelihood to change social relations impossible. As stated by Badiou (2010) regarding control societies, *ubicomp* would be presented as a true prohibition of fate.

Thus, in the face of destruction of attentional, social and environmental ecologies, Stieglerians rehearse diverse resisting tasks. They would lead, for example, to create intelligent urban areas that would serve to support new citizenship relations and attempt to revitalize democracy; furthermore, they would engage in deliberate web-design projects that would enable the formation of singularities or would strive to revalue the production of knowledge in renewed distributive economies.

These and other alternative strategies (which we cannot review here) have a *leitmotiv* to create intellective and axiological schemes to understand the reticularity of networks (or digital milieu) favoring, as Simondon wanted, reintegration and mutual enrichment between culture and technology. This objective is also clearly visible in other authors when they push for free software (Greenfield, 2006) or when they strive for public and generalized knowledge to open the *ubicomp* (Milner, 2006). In the last term, this is about a policy of encrypted techniques to make the *phármakon* to be a remedy rather than a toxic element and therefore enable the opening of new social relations (or Simondonian trans-individuation).

Conclusions

We have wandered about three perspectives that link social and cultural dimensions with the *ubicomp* program, which allows to look at new research directions. In the first moment, we stopped in instrumental analytic trends willing to identify the impact, application and adoption of these developments. In this sense, new studies could replicate these solutions in the short term in other institutional and social contexts. Regardless of current scopes of these projects, we expressly quoted Latin American thinkers to warn about the need of works in the field of design, but also about their

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deliberate limitation. In brief, quantitative and qualitative approximations are still missing to assess technological solutionism inherent to the program of omnipresent IT as one of the most developed and risky facets in our land.

Facing trends towards technological paternalism, we underscored that from the same design areas, there arose positions that would note the complexity of *ubicomp*, as it is seen as a surface for the production of practices of daily life. Thus, it would not be difficult to design ethnographic approximations that would recover the production of meaning in educational, recreational, and labor practices that would vary with the introduction (as a refounding) of intelligent ambiences and of elaborate situations by proactive computing.

This gaze at the dynamic texture of the program has also allowed, in a second term, to review the main ethical dilemmas and cultural criticism emerging in relation with the omnipresence of IT (topics such as autonomy and responsibility, capacity of control, privacy, et cetera). Here, new ways of research that should incorporate both the theoretical work and empirical and concrete inquiry because the characteristics of agency in the technological networks of *ubicomp* question the classical forms of the attribution of responsibility of the action, obscuring interests and blame. Maybe, for the time being, only specific inquiries of specific cases keep a positive heuristic to settle many of the ethical dilemmas envisioned by the authors in this work.

Lastly, political topics are analyzed through liberal positions calling to recover democracy in the face of IOT, and then stop in more critical positions that see an acceleration force of the *ubicomp* program in capitalism, which underscores problems such as commercialization and militarization of daily life. In tune with this, there is a third trend thinking about omnipresent IT related with ontogenetic and techno-genetic dimensions, as the frugal character is accentuated of the human face on the granularity of a variable silicon wrapping (shroud computing). In this sense, the lines of work should integrate both conceptual discussions opening the hiatus between culture and technology, and specific development projects that exceed classical paradoxes of technological instrumentalism in perspectives as a whole.

As the first decade of our century reached its half, Greenfield (2006) warned that, during the peak of the *ubicomp* program, few developers had a vision as a whole or worked consciously on their basic bricks. He upheld that maybe they have never heard of the syntagm paradigm "ubiquitous computing" or its derivatives, dedicated to specific problems, such as calibrating the sensibility of a sensors grid, designing RFID equipment, operationalizing algorithms, achieve articulation between communication protocols, et cetera. A similar case could be mentioned in respect to the multiple studies that analyze certain social and cultural dimensions related to the *ubicomp*, with empirical referents in this program, but unaware of their history and prospective.

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In fact, while analysis nowadays is not missing to display on the so-called social networks and which have multiplied the options inquired by algorithmic fabrics, few have elected to examine the spider that quietly and laboriously weaves and restructures the webs of daily life. With a lot more than eight legs mounted on the relations of power and the forms of knowledge, the ambitious program of *ubicomp* needs to be rebuilt and rethought aimed to the profoundness of its agency.

Indeed, no harm ought to be given to the virtuous heterogeneity of partial and limited analyses, neither speaking about *ubicomp* should be equivalent to and block the different ways of expression of technical operation and different engineering designs. Therefore, a first contribution of the arguments discussed above has been to recover the gaze on the multiplicity of developments and interpretations keeping the possibility of escaping from the outbidding impression as a positive valence between the different entrepreneurial strategies (common narrative of diverse approximations to our topic). In any case, resetting the whole gaze on a continuing I+D+i program enables the opening of genealogies on the different manners of understanding changing relations between technologies and social formations.

Strictly linked to the foregoing, as stated by Ekman & Diaz (2016), we have not yet deciphered the best way to approach cultural practices and social dimensions involved in ubiquitous computing. This is a difficult task, because, on the whole, these developments have had a surreptitious goal to become invisible, but also because studies seeking to reunite and discuss different perspectives have been scarce.

Hence, in the face of this plurality, our goal was to track the mutations of analytic trends that have emerged to grab the subtleties of this program, which allowed us to understand that the social and cultural thinking has not remained unconcerned in the face of the dissemination of *ubicomp* in daily life. This is the second contribution to this work, because if Weiser, as anticipated, intended to turn social sciences and humanities into strategic fields to push his program, only by rekindling the complex and diverse scenario of the multiple approximations of our disciplines may risks be anticipated and possibilities extended.

In the third place, we have attempted to state that the problem of the technical genesis of the *ubicomp* tends to disentangle the knots of thematic items as interconnections are multiplied in every sense. As may be ascertained in each of the passages we worked on, technologies are not immediately made homologous, but they do relate in their design in the program. Maybe it is time for criticism to be written from IT techniques, as shown by the reappearance of Kittler's (2002) thought. In his last contributions, the German thinker was investigating what was called the Turing Age, where data processing, storage and transmission capabilities had the universal media of *ubicomp* as their pinnacle.

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However, to Kittler (2002), the omnipresent IT was hand in hand with a growing computational illiteracy, which could be solved only by turning down the barriers between the humanities and computer sciences and by exploring open hardware alternatives against corporate interest. Without being positions equivalent to Simondonian studies, the recovery of Kittlerian arguments may help in overcoming the hiatus between culture and technology (which, as mentioned in the third section, will not be without political consequences).

In the last term, all of these perspectives gain actual force in their own complementarity. To some authors this is about cutting a future, vesting it with a direction and anticipating new transformations; to others, it is about better understanding a present complex which already is among us. Regardless of temporality adopted, *ubicomp*'s I+D+i program entails a profound transformation in the formations of knowledge, in the relations of power and in the modes of subjectivation of contemporary capitalism (*cfr.* Rossi, 2018a), and opens new sign and materiality regimes whose substrates we usually dub as information, data, metadata, markup languages, protocols, algorithms, voltage differences, non-conventional interfaces, telecommunication frequencies, standards, astute artifactualities, etcetera.

This is about a new set of equipment and agencies which set the circulation, modulation, control and compositions of different relational dimensions in the grown habit of computing our contemporary social formations. This movement, in turn, has extended, as summarized by Parisi (2013), in the definition of and limits of that which is computable. Therefore, understanding the multiple perspectives from which these practices have been investigated is the task of the age in which they are changing our ways of thinking about ourselves. An age which goes beyond the theological shape of the adjectives of omnipresence and ubiquity –which may lead to resurgence of arguments in favor of divine salvation under peril–, the political thinking finds that technicity and philosophy would be two sides of the same coin.

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[1] These companies were earlier emblematical cyphered by Xerox, IBM, Philips, Intel, Olivetti and nowadays they are cyphered by Google, Amazon, Facebook, Microsoft, Apple, et cetera. At the same time, it must be admitted that, from its onset, entrepreneurial inquiries were followed by inquiries at British, Japanese and US universities. Governmental agencies also emerged which encouraged the I+D+i program (as an initiative for the Disappearing Computer financed by the European Community).

[2] There also are warnings and general political objections, such as those of E. Sadin, as he refers to a robotized-growing life, in view of so much change in the anthropological condition, or those of M. Bunz, in respect of journalism transformations. At the same time, philosophers, such as B-C. Han, have not stopped observing the relations between contemporary psycho-politics and data intensive calculation, in the same way as the German M. Ott, who refers to the phenomena of *ubicomp* as makers of *dividuals* (as will be seen) in relation to the Deleuze-Guattari topic of societies of control. Evidently, due to space limitations, we will not be able to work on all the contemporary expressions of this political criticism.

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[3] Mosco (2017) will make a stop on the political economy of digital capitalism of the Big Five as they replaced the former think tanks that gave rise to computing ubiquity. Notwithstanding, to the author, we have to think that these are connected and intertwined developments which also express US military power and that, currently, they only have an alternative hegemony pole on Chinese digital platforms (Alibaba, Baidu, Tancent, QQ, WeChat's, Wanda, China Telecom, Huawei, Didi Chuxing, et cetera). It is needless to underline the fact that Next Internet is intimately connected to the global economic policy and to contemporary geopolitical tensions of the so called trade war.

[4] As may be seen, for example, in the growing volumes of energy consumed by both mobile devices and connectivity infrastructure (Haleem in Khosrow-Pour, 2018).

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