Ubicomp, Urban Space and Landscape

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Abstract
This article discusses the use of Ubiquitous Computing Systems (Ubicomp) in the design of urban revitalizations and refurbishments, using a specific methodology that considers Information Technology (IT) as an additional instrument to harmonize the urban scene with the landscape, minimizing the impacts that those processes can bring. The hypothesis is that when IT components and services are strategically deployed – respecting the structure of the places – they can introduce computational resources that will allow human activities to better harmonize with the landscape. This hypothesis is based on Heidegger’s thoughts, when he reflects about the concept of “circumspection”, meaning that when a technological apparatus works well, its presence recedes in the human consciousness. When components and services of IT are deployed strategically in a place - respecting its topological structure – those devices and services can add computational capabilities which improve human activities and make them integrated with the natural environment in a coherent and continual gradient of meaning, functionality and technological availability. Thus, human activities can better harmonize with nature by means of the use of ordinary objects and spatial elements that act as interfaces to access computational services, supporting the activities of a place, making them more efficient, producing less pollution, reducing their cost and energy consumption.

Mark Weiser’s idea about the evolution of Ubicomp also reinforces that main hypothesis. According to him, the spread of computational resources in the environment through Ubicomp will bring a new era of calm technology in which human dwelling will be supported by intelligent environments. To test that hypothesis, a theoretical framework was developed and applied by architects in three urban projects, in cities of United Kingdom and South Korea. Focusing on
the potential within IT components to promote qualities such as territoriality, privacy, identity and ambience, three case studies were described and analyzed. There are reasons for appropriately deploying IT based on the nature of the place and the activities that happen within it. The results show that a less physically interfering design can be achieved. Therefore, the projects become more ecological and sustainable, with more chances to harmonize with landscape. Conclusions are drawn and possible new research is suggested.

Keywords: Ubiquitous Computing, Urban Project, Architecture.

1 Introduction

Ubiquitous Computing (Ubicomp) is the model of human/computer interaction in which a computational capacity and its resources are accessed through devices and services of Information Technology (IT) integrated in the environment. They are integrated by means of being embedded in ordinary objects and spaces that are turned into interfaces as to allow interacting with people in order to detect, respond and represent some of their needs. The most common devices and services in an Ubicomp System are microprocessors, sensors, displays, actuators and links, among others. Due this new paradigm of integration with the space, the activities can be accurately scrutinized in terms of types of users, frequency of use, origin and destiny, personal preferences, special needs and other characteristics. This information can trigger different types of arrays of spatial elements and equipments as to promote quick changing in the built environment, for instance, to adapt the function of the environment to new activities, or to save energy, or to improve the security, the user’s satisfaction or merely to monitor the equipments.

2 Mark Weiser and the disappearance of technology

In the middle of the decade of 1990, Mark Weiser coined the term Ubiquitous Computing to refer to the conjoint of technologies that would allow, in the near future, the installation of computing resources in the environment to be used by people within built spaces. That use, according to Weiser, would not happen by means of stressing and complicating interactions, but, instead, it would be an intuitive and intelligent manner to use the components, with lots of computer spread to support the user in her/his activities, every time, everywhere. Using as interfaces the quotidian objects and spaces to access the spread computing resources, the user could thus concentrate himself better and easily in her/his main activities, putting in the periphery of her/his attention what would be out of the original focus in that moment. Weiser summarized that idea, deeming that one day computing would spread to and be embedded in the environment. About this, he commented: “The most profound technologies are those that disappear. They weave themselves into the fabric of the everyday life until they are indistinguishable from it”[1]. He exemplified that comment using currently
trivial facts as the use of machines and gadgets which are integrating ours lives, such as cars, phones and other devices which we do not pay attention to. He called this technological era “Calm Technology”, a future mentality, where interfaces would be designed to be intuitively used for a number of reasons: the existence of new technical achievements, massive miniaturization of components, cost reduction, and an intelligent systems design.

But Weiser, despite all the causes of industrial design, recognized that that new era of calm technology was a consequence from a human need. He commented that: “Such a disappearance is a fundamental consequence not of technology, but of human psychology. Whenever people learn something sufficiently well, they cease to be aware of it. (...) Computer scientist, economist, and Novelist Herb Simon calls this phenomenon ‘compiling’; philosopher Michael Polanyi calls it the ‘tacit dimension’; psychologist TK Gibson calls it ‘visual invariants’; philosophers Georg Gadamer and Martin Heidegger call it ‘the horizon’ and the ‘ready-to-hand’, John Seely Brown at PARC calls it the ‘periphery’. All say, in essence, that only when things disappear in this way are we freed to use them without thinking and so to focus beyond them on new goals.”[1]

This conceptual similarity with others thinkers allow us to understand, specifically through Heidegger’s thoughts, the consequences of a common vision of technology, while helping us review other spatial implications [2] for the individuals associated with the natural and built environment. To Heidegger [3], the term “ready-to-hand” points out a kind of entity that was turned into an equipment by means of human labour. So, elements of nature are “present-at-hand”, which means they are not for a specific purpose, but when human beings work on them, they are turned into equipment. The essence of equipment is being for something, which means, its essence is its finality. Heidegger observed that when we use equipment, our consciousness becomes subordinated to its function and it starts to integrate its usage itself. He called this “manipulating” which means a primeval understanding that we can have about the entities “ready-to-hand”. This way to understand the world differs far from the second hand way to understand it, when we know something but without ever having experienced it.

3 Characteristics of equipments in Heidegger

For Heidegger, the meaning of an object ready-to-hand emerges from its links to others objects ready-to-hand which provide support for human beings. Since those objects are called equipment, he called these links among objects the “equipmental nexus of the things” [3], meaning that what is an object will depend upon its contextual functionality more than its cultural meaning, given in the time or in the space. When we are using a ready-to-hand object, we are more concerned and absorbed with our goal than with the equipment itself. Thus, when ready-to-hand objects are genuinely effective, they become “transparent” [4] and unnoticed for us. In this situation, we are not busying our mind with their immediate presence and our consciousness becomes a whole with the utensil we
are using exactly by means of the usage. However if, instead, it breaks down and stops functioning, it starts occupying our mind again and becomes visible for us, conspicuous, requiring our attention to fix it. Our equipmental nexus of things also causes in our existence a kind of daily perceptual experience about the environment. Heidegger called it “circumspection” which means a kind of careful vision of things that does not imply in a deliberated attention in what is being done. It provokes in the subject a mental attitude where the perception of herself/himself is indistinguishable from the totality she/he makes with the action itself and the use of the equipment. This mental state is similar to the attitude that many professionals can have due to the accumulation of knowledge or skill with time. That gives them not the mechanical appearance of a robot but, instead, extreme ease while operating equipments. At the same time, they will look as though they were acting without much thought [4].

4 Natural and Built places as equipment

By using those concepts it will be reasonable think that both architectural [5] and urban spaces [6] can be grasped as identical concept categories, which means they are linked equipments whose final purpose would be to permit humans to dwell on earth. Natural landscape is, in this way, a background composed by “present-at-hand” entities, over which built spaces are understood as figures. Concerning architectural and urban studies Norberg-Schulz emphasized that the symbolic value of the built space, related to the landscape [7] is a relation similar to the figure and background concept, which he borrowed from Gestalt. It means that the idea that the totality of human environment is much more complex than the simple idea that that totality is an addition of those two terms. Norberg-Schulz pointed out that it was necessary to understand that the structure of the environment is similar to a universe of linked vertices, which would be composed of natural and human-made places. The links between both domains represent a continual gradation from the natural to the built environment. Thus, the concept of harmonization would be much more related to a gradual and continual link of values given by human beings from natural to human environment structures than a quest for a new kind of aesthetic research. We need now to understand how such universe of links can be integrated by components of IT in order to better strength and improve the continuity from the natural to human domain using Ubicomp.

5 Ontology of Natural and Built Places

Maybe the first step to understand how natural and built places could be taken as having the same structure is asking about their ontological similarity. When we consider places as equipment to dwell, we should realize about them as equipmental nexus (Figure 1).
Through the *equipmental nexus* analysis, natural landscape can be taken as a bigger group that are linked to other more complex structures which, by their turn, are linked to natural and built places (the former as architectural and urban places). For all those spaces inhabited by human beings, maybe it is possible that the ontological principles pointed out by Malard [5] would be useful to explain how people differentiate spaces into places and attribute them their qualities (Figure 2) as territoriality, privacy, identity and ambience, which are common to natural and built places. When there is no way for humans to remain within the natural landscape, because it is unfit to live in, we will call them uninhabitable areas, but we can take them as frames for natural and built places [8].
dysfunction of its spatial elements what will affect those mentioned qualities [5]. Then, detecting which spatial elements are broken down is a necessary task to improve the qualities of places and detecting them can reveal common categories related to those qualities. We need now to clarify what are the spatial elements of places and how they are related to territoriality, privacy, identity and ambience.

6 Topology of natural and built places

The interiority of a place is defined when enclosures (5) delimitates an internal area (2), which has a centrality (1). These elements qualify the place, turning its interior in a territory. Simultaneously, the association of enclosures plus the entrances (6) controls the manner through which the place is connected to the exterior, specifying its privacy and the way it can be visually identified from outside. Human actions inside the delimited internal area in both horizontal and vertical directions would define simultaneously the identity and the appropriation, showing off how people care about that place dedicating it attention and making it an ambience.

Figure 3: Topological elements of a place studied by Souza [9]:
1) Centre; 2) Internal area; 3) Horizontal Directions;
4) Vertical Directions; 5) Enclosures; 6) Entrances

That topology explains how natural and built places can have their elements analyzed through the similar categories in a manner that that analysis puts out how those elements can be correlated to the qualities as territoriality, privacy, identity and ambience.

7 Environmental Discontinuity

It is necessary now to clarify how natural landscape and natural and built places can harmonize with each other. Norberg-Schulz [7] pointed out the need of a
conceptual definition similar to what Heidegger called the equipmental nexus, meaning a connection between the internal world of a place and its coherent transition towards the outside natural world. So far we have mentioned that that transition can be grasped as a coherent and continual transition that can be classified according to at least three categories: symbolic, functional and technological. Through those categories one can see and analyze the places coherently, with coherent transitions from their interior to their exterior but always supporting their main function as dwelling places. Thus, we can understand that the harmonization between natural and built places, between landscape and city, would depend upon that transition, which means it would be the coherence among their symbolic elements, their functional factors and resources, their building resources and technological scene. The whole environment, when we are craving for integrity, would propitiate that the built places, therefore, give us fruition, functionality and would permit being more resource consumption manageable while providing a meaningful connection with the natural world. The environmental discontinuity would be the main problem which results in pollution, visual chaos, disorientation and lack of identity in the great urban centres. In private life nowadays that discontinuity is given by the style of the houses of the parvenu, with their interiors looking like museums, detached from the world and isolated, demonstrating the quotation which says “my home is my castle”. Those insular portions of disconnected places, scattered over the world, would obstruct the environmental continuity as nodules of contrast, framed by meaningless spaces as tiresomely long highways and uninhabitable areas with landscapes destroyed by human exploitation.

8 Architects concerned with better places through UbiComp

According to John Thackara [10] we live, for a while now, in a technological dilemma where the most of what is being produced by industries is a response to the fact that the technology allows it to be made, more than a response to real demands of the society. Regarding the truth supporting that point of view, we can say that the focus of the technological development should be the value that the industrial development adds to our life more than the innovation it can introduce, showing itself off as a “ingenious solutions”. In other words, our industry are more concerned with how to make things than with answering why those things were made, and their meaning to us. Reflecting about the use of IT in the last 10 years, some authors considered its influence on society, some emphasizing internet resources, wondering whether that connectivity would shorten physical distances [11] and create a generalized interactivity based in the pervasiveness of the technology [12]. Using metaphors based in the common sense about space and place, those authors referred to the web connection interfaces as an electronic space or cyberspace, that will dissolve the physical place and the city [11]. With the Virtual Reality Technology, those authors imagined that cyberspace would finally offer the subtleness of immersive communication, possible so far in the real world, making unnecessary the real places. Mitchel [13] formulates that there was, in that moment, a crisis in the
physical dimension of the place, the region and the city: “Net negates geometry”, he said. However, some years later, many of those deterministic predictions did not pan out. Instead, IT is being studied now as part of the material production of spaces, reinforcing the importance of localities and how it interferes over the design of places recursively. In this sense, and this reverses the idea stated by Mitchel, McCullough stated that [14] “contextual computing starts from physical geometry” of the places. Searching for real demands to be responded with the use of IT applied in places, architects and environmental designers now are concerned simultaneously with the improvement in the physical conditions and in the communications that support activities. The framework that we are introducing here tries to justify the use of Ubicomp as a search of harmonization between places and landscape. To do so, it is necessary to focus on an ecological view of information.

9 The framework

Using the paradigm that the modifications that living systems impose on the environment belong to a linguistic domain [15], we understand that the term “information” should not be used as its mechanical conception in Shannon [16], to whom it was a conveyer of meaning. Quite the opposite, spatial organization created by living beings, in the natural environment or built one, is tied up with their ability to co-operate and adapt themselves. Language, a human privilege, depends upon the concrete environment to create meaning, i.e., space itself is information[9]. Humberto Maturana [17] has exemplified the linguistic domains of living systems in the environment as the following picture.

Thus, it is possible to infer that, from an external observer’s point of view, the physical characteristics of the environment, added to the history of its transformations, could be considered part of a linguistic domain. The ability of a living being to modify its environment to adapt it and survive could be understood as a particular kind of communicative behaviour, specified by spatial interactions. Since the environment is modified by the systems that live in it, it could also be said that this situation is communication.
10 Analysis

Thus, it would be possible to wonder how the spatial elements are correlated to an IT component aiming to reinforce the qualities of places. An analysis [9] has demonstrated that the components of IT, such as sensors, microprocessors, electronic tags, communication links, among others, can be regarded in relation to topological situations which interfere with the qualities of the places. That allows a description of IT components by means of their positive potential to support local qualities. The following table is part of that analysis [9].

<table>
<thead>
<tr>
<th>Territoriality</th>
<th>Privacy</th>
<th>Identity</th>
<th>Ambience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interiority and exteriority</td>
<td>Visibility</td>
<td>Visibility</td>
<td>Appropriation</td>
</tr>
<tr>
<td>Sensors detect action, measure physical quantities such as temperature, pressure or loads and convert it into an electronic signal of some kind.</td>
<td>Sensors are related to privacy by sensing proximity, invasion, thus permitting surveillance, and informing when an action is needed to react against invasion.</td>
<td>Sensors could permit identification of visible users according to their tag. They could also permit users to identify specific elements according to specific concerns.</td>
<td>By the use of sensors, technology, they could sense mechanical movements, adjustments in order to tune the system, distinguishing how the user appropriates the place.</td>
</tr>
<tr>
<td>These could integrate systems in order to sense changes in temperature, pressure, light, when the user tunes the system, allowing information about how the user appropriates the place to be gathered. They would permit the creation of reflections of info about those variables in order to trigger actions.</td>
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Figure 5: Table of correlation between IT component and the qualities of a place [9].

Using the previous concepts, a framework was created to help the design of the use of IT by architects in the project of urban places. That framework consisted of asking the architects to identify conflicts between malfunctioning spatial elements and the activities they should support. Thus, using the scheme showed in Figure 3, they explained how the missing or broken elements were interfering in the four qualities (Figure 2). Detecting the missing element and interpreting how its interferences were related to spatial attributes, the architects established how a component could be articulated to the space in a system to support the affected activities, using the table above.

By the years of 2005 to 2007, three urban refurbishments were made by architects in the UK using the framework described to support the design of the use of IT in the place. The limits imposed to qualitative solutions when the approach was used partially or in its integrity were studied. A first team (team A) tried to find pragmatically local problems to given solutions based only in the reflections related to the qualities of place (Figure 2) without any other theoretical frame. The second team (team B) identified the missing or broken spatial elements which were in conflict with the activities, given solutions with IT but
partially using the framework, which in that time ended with the distinction of elements and services of IT able to be applied in the place (elements to sense the place, to act in the place and to represent the place). The third team (team C) used the whole framework here described, deploying IT components and designing complete systems of Ubicomp. The analyses of the projects previously mentioned have demonstrated that team C used less physical interfering solutions, while team A provided the most intrusive solution, with many physical and expensive recasts.

Those experiments confirmed Mark Weiser’s ideas, observing that when an Ubicomp system is designed according to the logic of activities and spatial structure of a place – as the solution of team C – then physical interferences can be minimized and the technology applied tends to disappear, not being perceived. When this does not happen, as in the solution of team A, the solutions appear to be attempts to exhibit the technological apparatus without a correct concern for local qualities, imprinting a feeling of discontinuation in the environment, making that the function and fruition of the place were stuck in the place.

Reflecting about those experiments, we concluded that when we design an environmental continuity using Ubicomp, the harmonization between built elements and the landscape probably is improved by means of the graduation of technological, functional aspects and symbolic value. In this manner, Ubicomp could participate in the harmonization between the human and the natural, demanding new research where, instead of posing itself between those former two universes as a barrier, IT will act as a bridge linking the human presence with the world.