URBAN MEDIA GEOGRAPHIES: INTERFACING UBIQUITOUS COMPUTING WITH THE PHYSICALITY OF URBAN SPACE

ACHILLEAS PSYLLIDIS

PhD Candidate

The Why Factory & Hyperbody, Faculty of Architecture

Delft University of Technology (TU Delft), The Netherlands

Co-author: Nimish Biloria

Assistant Professor and Research Manager

Hyperbody, Faculty of Architecture, Delft University of Technology (TU Delft), The Netherlands

Abstract

This paper aims at establishing an associative relation between the proliferating digital technologies, the physical context of the urban fabric, its inhabitants and the multiplicity of their activities as an emergent phenomenon of contemporary urbanity. It introduces a methodological framework for the development of an interactive urban system, installed within urban open public spaces, in the form of a hybrid interface that can serve as a platform designated for both citizens and municipal planning authorities. This particular system harnesses and analyzes real-time, quantifiable traces of diverse everyday urban activities and subsequently feeds this analyzed information back in a looped manner to citizens via the proposed public interfaces. Subsequently they can observe, interact and declare their own activity-driven, customized spatial and infrastructural usage and transformation alternatives. In other words, the platform does not only imply interaction at an information exchange level, but rather aims to provoke a complex variety of inter-relations between the social and the technological via real-time spatial adaptation and customization possibilities. The proposal focuses towards a system that is perceived as an integral part of the urban environment and less on the development of a specialized application or website platform that only overlays an additional virtual layer to the already existing ones in the contemporary cities. By devising such a socio-technical interaction-driven approach towards urbanism, our proposal intends to deploy a trans-scalar understanding of the emergent relations between people, space and ambient technologies that can, further, enrich the urban pluralities within the twenty-first century city.

Keywords: Urban systems; Interaction design; Urban computing; Real-time city; Media geography; Ambient interface

1 Introduction

Cities are manifestations of multi-relational networks, which perpetually become far more complex as we experience a shift from industrial economy to one driven by the forces of (digital) information and services. Two of the most critical phenomena that drive the proliferating complexity of the contemporary urban configurations can, on the one hand be identified in the rapid global urbanization processes and on the other, in the perpetual pervasiveness of information technologies within the urban milieu. Both of these phenomena necessitate us to rethink about the complex urban-medial relations constantly emerging, and the way in which they are expressed within the various urban environments.

In more specific terms, owing to the acceleration of global urbanization processes we are currently encountered with increasingly overlapping urban populations as compared to rural ones. Already since 2007, more than half of the world's population lives in cities and, according to UN predictions, by 2050 it is estimated that this percentage will rise up to 70% (United Nations, 2007). As a result, humans are already — and progressively become — an "urban species" (Moere and Hill 2012).

Nevertheless, apart from the consecutive emergence of new urban agglomerations, most of the Western and progressively many of the non-Western societies have shifted towards an economy, driven by (digital) information and services. An apparent repercussion of such a shift can be identified in the amounts of tangible patterns and traces regarding human urban activities. Industry-driven societies have been characterized by a plethora of visible activity patterns in the physical spaces of the city, reflecting the production streams (Moere and Hill 2012). But, as ambient technologies subtly diffuse within the urban environments the "by-products" of human activity, in turn, become less and less traceable. These digital, invisible traces – representing the contemporary city's "pulse" (Leach 2009) – figuratively appear as an additional, intangible layer hovering above the urban fabric.

We argue, though, that this particular perception of ICT media and the derivative ambient data as a superimposed layer over the existing city, implicitly suggests that information is incapable of drastically affecting the urban layout. Such an overlaid ontology presupposes the dominance of the built components over the informational ones, rather than the latter being part of or equal to them. Driven from such perspective, in this paper, we challenge the idea for a model of urban systems in which the diverse amounts of data derived from social activities become equally co-constituting with the physical environments they belong to. We propose a methodological framework — currently in progress as part of an on-going PhD research conducted by the authors — for a complex urban system plugged into existing open-air public spaces, which receives data as real-time streams and acts upon processed meta-data. The quantifiable digital traces of urban activities are constantly fed back in a looped manner to both citizens and municipal planning authorities, via public interfaces, providing them the opportunity to develop an active dialogue upon diverse datasets, with qualitative outcomes. However, as cities comprise not only infrastructure, but also people that inhabit them, this research intends to focus mostly on the social and behavioral impact that the proposed system can instigate at different scales.

2 Extracting the Urban Pluralities: The City as a Real-Time Relational Model of Urban Data

Despite the affluence of paradigms engaging urban systems that are based upon pervasive computational technologies, there is a certain amount of ambiguity regarding what the term "urban system" essentially expresses. It is, thus, important to firstly set the theoretical underpinnings of how we conceptually perceive the urban system in our proposal. The following paragraphs outline such theoretical foundations and, further, delineate the essential characteristics of the PACT design framework, as a methodological tool capable of identifying user-centric variables that can be utilized for the extraction of the system's requirements.

2.1 The Notion of "Urban System"

In general, a system — derived from the Greek word σύστημα (systēma) — can be characterized as a set of inter-related, yet autonomous elements. According to Harvey, a system can be more accurately defined as a set of elements with certain variable characteristics (attributes), along with a set of relations between these element-attributes, as well as a set of relations between the element-attributes and the environment (Harvey 1973). It is this particular characteristic that diversifies an open from a closed system. Open systems interact with their environments while closed ones do not. Complex systems, including cities, are necessarily open, meaning that all their constituent elements along with their corresponding attributes can change in time owing to the inter-relations developed between them, as well as between the system they constitute as a whole and its environment. Within this approach, our aim is to perceive the proposed urban system as a constituent part of the city, embedded in the physical fabric. In this way and by its physical presence, it can allow for more tangible interactions than a virtually controlled application (e.g. mobile phone application, web blog etc.), pertaining to incessantly looped information derived from urban components of different scales and natures. Such a system notion, further, implies the necessity for a relational model of diverse patterns of urban activities. Unlike the current prevailing approach of treating various quantifiable activity traces (e.g. occupancy levels, transport and mobility patterns, energy data etc) as individual systems, it is important to begin studying the impact of these traces as a result of the interdependent relations that can be established between the diverse infrastructures and people, in a more sustainable and interactive manner. Hence, we believe that the aggregate of the interconnected sub-systems will start performing as an organism that adapts better to its environment and caters to the needs of the citizens, while further enhancing the efficiency and services of the city, in which the sub-systems are embedded.

2.2 Identifying the Trans-scalar Variables: The PACT Design Framework

A subsequent challenge emerging from the aforementioned relational approach is to determine a methodological tool capable of identifying variables within a user-centric and spatial perspective, so that the system better addresses the citizens' needs. A generic tool supporting such a relational perspective, widely used in the field of interaction design, is the PACT design framework, which is an acronym for People, Activities, Context and Technologies (Benyon, Turner and Turner 2005). This particular framework creates a synergy of the four components by establishing a single statement; people undertake activities in (certain) contexts using technologies (Figure 1).

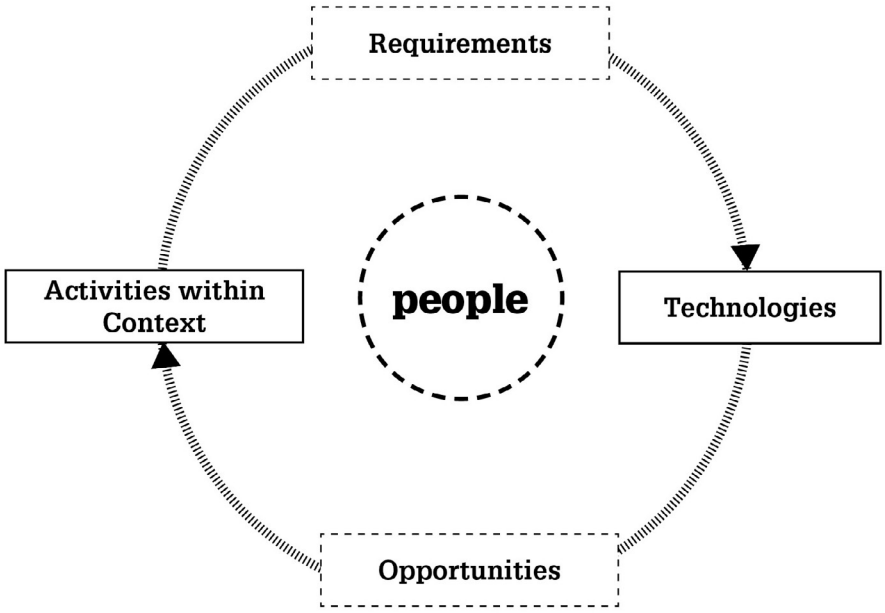

Figure 1.
The People, Activities, Context, Technologies (PACT) design framework's rationale.

It, thus, qualifies as a logical concept to sustainably study the interdependent relations between the four components. In our case, the application of the PACT analysis-driven tool is intended to derive an understanding of the immediate urban context surrounding the proposed system in its entirety (different users, kinds of activities and the context) and to, subsequently, derive a rationale towards a technological articulation needed to support activity typologies. This is of major importance, since we are aiming at a case-specific urban system. Urban data stemming from occupancy levels of a specific public space, or demographics can provide an essential insight into the operational components, especially those referring to people and their activities in the case study areas.
The activities taking place within their corresponding contexts give rise to a set of technological requirements. In turn, any technological change affects the manner in which the activity within a context is performed. Though the exact elaborations as regards this design framework fall out of the intentions of this paper, what is important to be comprehended is this particular cyclic nature of interactivity among the four components, which is vital for the attainment of a successful socio-technical urban system.

3 The Rationale of the Interactive Urban System

Founded upon the aforementioned theoretical principles, the proposed interactive urban platform aims at exploring an emergent form of media geography that reinforces the mutual relations between the social dynamics of the city and the ambient embedded technologies. Its goal and principal challenge is to provide a physical, responsive interface that goes beyond attractive visualizations of crowd-sourced information, towards a system that can trigger behavioral and spatial adaptations facilitated by the digital traces of physical urban activities. The system's design philosophy is, thus, established on these interlocking loops between the physical and the digital – the social and the technological – while incorporating three fundamental functions: urban data sensing and gathering, indexed data simulation and visualization and, ultimately, feedback loops via public interfaces that can drive real-time infrastructural adaptations within a certain impact radius (Figure 2).

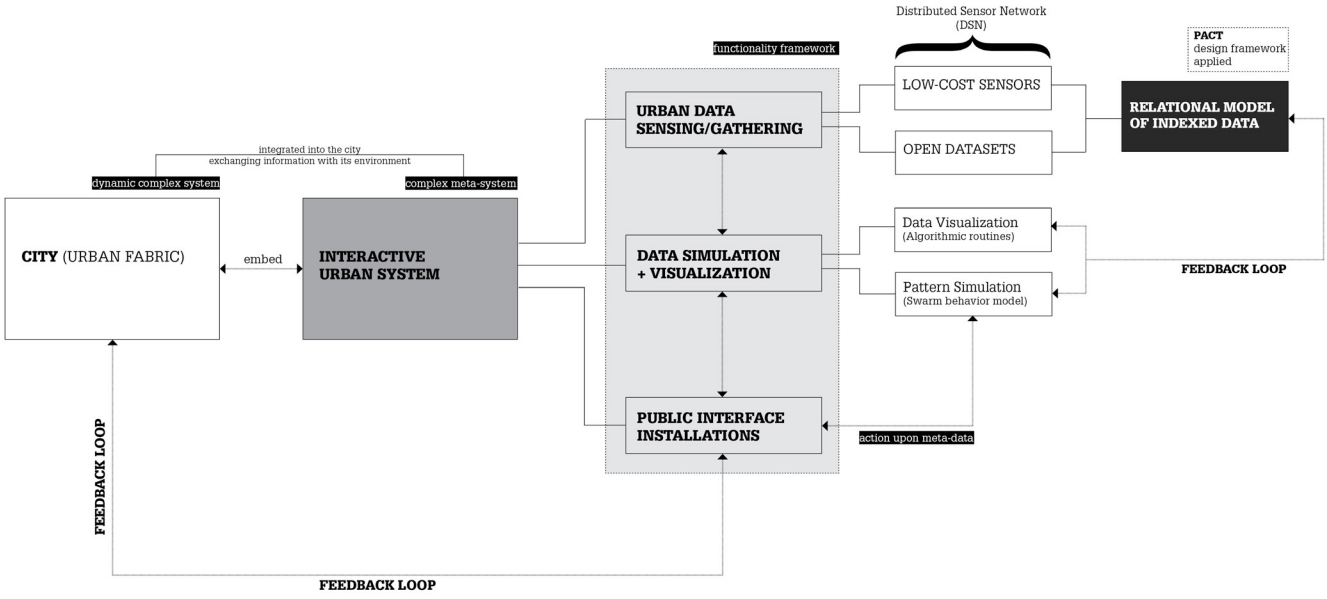

Figure 2. Diagram of the general functionality framework for the proposed urban system.

The platform embodies a physical sensing network consisting of low-cost sensors, which are distributed across a certain area. To keep the cost level as low as possible, the system utilizes existing open datasets from governmental databases and open-source soft- and hardware (Processing programming language, Arduino and Servo motors). Through these procedures, the goal is to create a relational model of the indexed datasets, so that the impact on the urban fabric, derived from quantifiable measurements, will not only respond to individual parameters, but would rather refer to the repercussions resulting from a relation that can be established between different elements and attributes of the city (e.g. between people and traffic levels, between people and environmental conditions etc). The system can, further, engulf variable quantifiable attributes from its immediate environment, while remaining open-ended for plugging in different parameters that address emergent patterns.

Following the data harnessing process, the system subsequently simulates, analyses and visualizes the digital activity traces, with the assistance of customized scripted routines. This procedure is developed not in a linear, but rather in an iterative way, where urban data are constantly fed into the software platform in real-time and the visualized outcomes are ultimately communicated via public interfaces. The traced data monitored in our research, specifically, comprise occupancy levels in different time spans, transport and mobility patterns as well as real-time energy data (e.g. CO2 emissions, electricity usage etc). In turn, by illustrating the processed quantifiable measurements on the public interfaces, we expect qualitative feedback from the citizens themselves who integrally co-constitute the perpetual variety of information sets. To simulate the human activity patterns within the study areas, a swarm-behavior model is applied, based upon the principles of C. Reynolds' boid behaviors (Reynolds 1987). Such a model depicts, in general, the behavioral aspects of a group of agents that may be able to perform tasks without detailed representations of their immediate environment, as well as other neighboring agents (Biloria 2012). Despite the fact that originally the model was devised to simulate complex natural systems, when applied in an urban context it needs to adapt to the artificiality of the city. The application of swarm logic, however, as a simulation tool to urbanism, favors the potential to explore organizational behaviors that evolve in time, derived from localized simple rules of action.

4 Case Study: A Potential Operational Scenario

Following the analysis of the rationale and fundamental principles of the interactive urban system, this section speculates on a potential implementation scenario in a network of public spaces in Rotterdam. Although this particular site comprises a contemporary Western urban configuration, two distinguishing aspects characterize Rotterdam as a challenging case study. Firstly, its multicultural diversity inasmuch as people from 173, mostly non-Western, different nationalities constitute half of the city's inhabitants (in 2011, according to the Dutch Center for Research and Statistics) and, secondly, its ground-up reconstruction and re-habitation after the sheer devastation during World War II. Such a multifaceted context can establish an influential field to attain a trans-scalar understanding of the multi-relational networks between people and space, utilizing the ambient urban platform.

Respectively, the interactive system is context-related, meaning that each specific area establishes different requirements and parameters that are being monitored. The nature of these quantifiable data determines accordingly which of the two interacting parties with the system – namely the municipal planning authorities and the citizens – acts upon what kind of information. More specifically, strategic infrastructural transformations pertaining to data derived from occupancy levels and mobility patterns, is substantially coordinated by the former; while the latter have the opportunity to declare through the system their activity-driven customized spatial alternatives.

The meaningful conclusions drawn by the space occupancy and usage configure the design principles and intervention recommendations that are, further, incorporated into the system. In this way, the citizens are provided with an expandable library of locally oriented design interventions, the boundaries of which are set by the planning authorities. Subsequently, citizens declare spatial customization alternatives adjusted to the aforementioned system boundaries that, depending on each urban area, can range from material, color and light levels arrangements to enhancements of vacant or latent spaces in the city (a phenomenon increasingly emerging in Rotterdam, but also observed in many contemporary metropolises worldwide). The planning authorities further, evaluate these customization alternatives and test their efficiency by utilizing the previously mentioned swarm-based simulation methods. Within such a framework they can be provided with an "artificial planning experience" of the repercussions that these spatial alternatives have within a specific impact radius, in a relatively short amount of time (Portugali 2000). Depending on the nature of the design alternatives, spatial and infrastructural transformations take place either in real-time or in a gradual pace. In turn, these urban transformations will lead to new emergent patterns, constantly driving the process in a looped manner. This multiplicity of entanglements between citizens and planners allows for the emergence of collectively defined urban re-configurations, facilitated by digital systems (Figure 3).

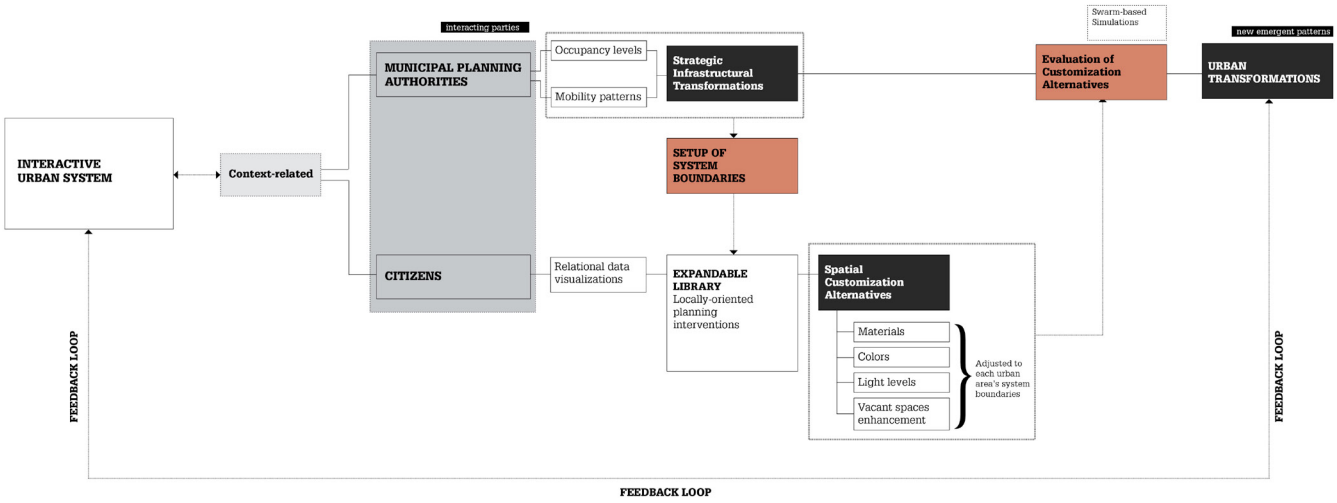

Figure 3. Operational diagram of the interactive urban system

5 Conclusions

The Urban Media Geographies proposal intends to interactively transform the physical urban fabric with the assistance of a dedicated system functioning as an interface to digital information, derived from social dynamics. Though such technological applications become increasingly neutral in the sense of the internal pluralities currently emerging in the contemporary urban environments, what we are aiming at through our proposal is to extract the general characteristics stemming from such variable cultural urban hubs. Following that, the derived parameters can drive our proposed installations, so that a case-specific system emerges.

We argued about the significance of physical presence within the urban fabric as a fundamental attribute of such a system, so that it provokes a hybrid interlocking between the immaterial flows of information and the material space of the city. The challenge is, thus, to provide interfaces that endow citizens with agency, rather than just giving them back bare data mappings. Nevertheless, it is crucial that municipal planning authorities also operate these interactive systems, in order to provide certain frameworks and boundaries within which citizens can declare their alternatives. Subsequently, our proposal does not aim at an absolute bottom-up or top-down decision-making strategy for the city, but instead favors a merger of both professional proposals and everyday people's suggestions, as an emergent hybrid approach towards urban design. The Urban Media Geographies proposal, thus, intends to develop a methodological design framework that can cater to both Western and non-Western urban environments, facilitated by hybrid socio-technical systems and decision-making strategies, as a sustainable approach for the twenty-first century city.

Acknowledgements

This research is co-financed via the act "Scholarships Program of the Greek State Scholarships Foundation (I.K.Y.) with individual evaluation procedure acad. Year 2011 – 2012" by the resources of the Educational Program "Education and Lifelong Learning" of the European Social Fund (ESF) and the NSRF, of 2007 – 2013. It is also funded by the A.S. Onassis Foundation, as well as by the Foundation for Education and European Culture (I.P.E.P).

References

Benyon, David, Philip Turner, and Susan Turner. Designing Interactive Systems: People, Activities, Contexts, Technologies. Harlow: Pearson Education, 2005.

Biloria, Nimish. "Interactive Morphologies: An Investigation into Integrated Nodal Networks and Embedded Computation Processes for Developing Real-Time Responsive Spatial Systems." Frontiers of Architectural Research 1, no. 3 (2012): 259-71.

Harvey, David. Explanation in Geography. London: Edward Arnold, 1973.
Leach, Neil. "Swarm Urbanism." Architectural Design (AD) 79, no. 4 (2009): 56 - 63.

Moere, Andrew Vande, and Dan Hill. "Designing for the Situated and Public Visualization of Urban Data." Journal of Urban Technology 19, no. 2 (2012): 25-46.

Portugali, Juval. Self-Organization and the City, Springer Series in Synergetics. Heidelberg: Springer-Verlag, 2000.

Reynolds, Craig W. "Flocks, Herds and Schools: A Distributed Behavioral Model." Paper presented at the ACM SIGGRAF '87, published in Computer Graphics 21(4), 1987.