

# Defining HCI/UX Principles for Urban Environment

Pavel Farkas<sup>(✉)</sup>

Faculty of Humanities, Charles University in Prague, Prague, Czech Republic  
pf@pfarkas.com

**Abstract.** Interaction design works successfully with several design principles that are widely implemented and used in the community of designers and theoreticians. In this article, the author argues that urban designers and architects who are designing built environment may very well face similar questions and problems as the interaction designers in Human-Computer Interaction (HCI) design. The text sets the design thinking and semiotics of interaction in a large scale and tries to outline the connections between the UX design and urban design for cities we live in. Moreover it targets means of interaction and attempts to encourage designers of to engage in turning our modern cities into more livable, user-friendly and inclusive environments.

**Keywords:** Architecture · Communication · City · Design thinking · Information · Interaction · Semiotics · Smart city · UX · Wayfinding

## 1 Introduction

We might tend to use our surroundings without thinking: our primary function in the city is less likely just traveling for pleasure and seeing the built environment: more often we travel to work, school or cultural events. We rush to get to the subway lines before our train departs, we run to the tramway before the door closes or peddle through the intersection before we hit red. Now, let's try to slow down and think about our environment the way we think when designing an interface. Let's see the design behind it, which may let us understand the built environment better, or appreciate the solutions that would otherwise go unnoticed. We may discover solutions that surprise us or enrich us in designing the user interfaces, because even city is supposedly designed with one aim in mind: to provide the inhabitant with an excellent user experience.

In this article, we will point out several conceptual similarities in information and interaction design between the built environment and user interfaces to illustrate the framework of thinking and to show how the philosophical connection between the two entities is being perceived. Further, we will consider a specific area of interaction in the built environment and draft possibilities for evolution within so called smart cities.

The nature of the problem discussed further lays in design thinking, which may be seen as a common ground for both, design of interaction in cities and design of interface interaction. Given that we can use the same terminology to describe problems in the built environment and in the design of interaction, the main research question is

whether or not we also can find similar solutions for problematic situations. Aside of precise demarcation of the term of interaction, there is a natural challenge to this problem, constituted by the particular differences of the character of interaction in either environments. But just as it is possible to try to build an ideal city on suggestions introduced by Alexander et al. [1], we may attempt to build a vocabulary used in the sole act of interaction among people and technologies within a built environment.

## 2 Basic Concepts and Principles

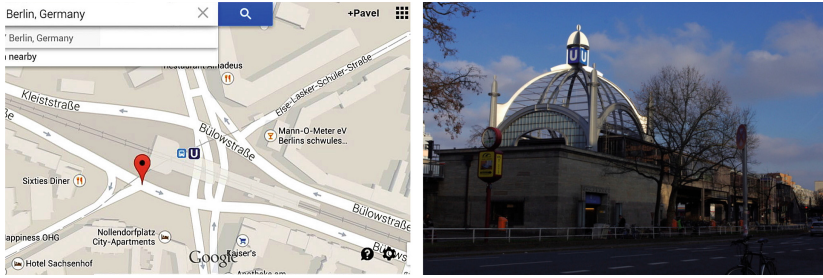
City is a system that works. In ideal conditions, that is. City consists of elements that provide information for a researcher, as well as for the user. Naturally, we can view the terms of information and system from very different perspectives: a Czech professor of information science Jiří Cejpek points out [4] that a person can be understood as a communicatively-information system themselves (...) whose brain processes information as some kind of metabolism. Let's presume that while a researcher may perceive an information gathered within a given city as an element of our knowledge letting us orient in the world, it is quite possible, that we expect our user to knowingly utilize only information that is intended to be read, perceived, processed and followed, as is, e.g. wayfinding information or directive signs. In this article, we will be aiming our attention to information in the physical environment that is not necessarily meant to be perceived by the receiver — instead, to information that is used inadvertently, similarly to the “flow” as described by Cooper et al. [6]. We will try to point out the similarities to the interaction design in HCI to introduce the framework of thinking and further we develop the possible benefit of interaction tenets for modern cities.

## 3 Basic HCI Design Terms Applied to the Built Environment

Among other authors in the area of design, Donald Norman [13] operates with well established terms for the interaction design praxis. Below, several most common principles will be revised and placed in a viewing angle of different kinds of human interaction within the built environment.

### A. Visibility

It is possible to argue that if a visual lead is not present in interaction design, a signified function in fact does not exist for the user. Of course, visibility is desirable in the physical environment as well. Figure 1 shows a street situation in Berlin. The metal construction above the subway (U-Bahn) station on Fig. 1 is well visible from all directions leading to this prominent intersection in Nollendorffplatz and creates a notable node, which is a term used in urban planning by Lynch [12] in 1960. His description of the built environment is still respected today by architects and urban designers and defines basic elements of a city that provide us with clear information clues. In contrast, we may mention Microsoft and their release of the Windows 8 system, with a very few visual leads, leaving the user wondering how to navigate in the system.



**Fig. 1.** Street situation (left) of Nollendorf station, Berlin, Germany. (Source: Google Maps). Nollendorf U-Bahn station is a significant example of a visibility concept in the urban environment (right).

### B. Natural Mapping

Mapping is a technical term meaning the relationship between two things, e.g., between the controls and their movements and the result in the world [4]. It is desirable to design the situation in a way that corresponds with the reality. Compare the situation on Fig. 2 and then imagine what a confusion would this kind of incoherency in design rules bring into the real world, for example, in a subway situation orientation system. The use of natural mapping brings significant benefits for the user in product design, information design, or geography design.



**Fig. 2.** LG cell phone (left) and Samsung cell phone (right). Note the opposite mapping principle represented by the position of the “back” button.

### C. Affordance and constrains

We may think of a physical environment (Fig. 3) when designing an interface (Fig. 3); the philosophy behind it is actually very similar. It only lets us do this much – and not more, often for our own sake. Interaction designers want to prevent users from making mistakes, while designers of environment do the same. Physical barriers are necessary in situations where there is a risk of fall. In other situations, like in a subway, they need to design the borders using a combination of visual and tactile tools.



**Fig. 3.** Sarasota, Fla., 2015. Compare the constrain (left) forbidding parking in a physical environment to a similar design principle in an interface of a Czech e-mail portal (right). There is a hidden constrain in this web mail client preventing users to click into the corner of the message window. (Source Fig. 3: seznam.cz).

#### D. Icons and symbols

Symbols or pictograms describe the reality in a simplistic way to prevent us from too much of cognitive load processing. Great graphic precision is not necessary; instead we need the user to choose appropriate direction or action quickly and without taking time to make the decision. Remember the “flow” mentioned earlier [6]. It is necessary that they are executed in a simple yet understandable way and without too much invention. Novelty can prevent the user from understanding the meaning of a given message: trying an innovating approach in every step may create backlash.



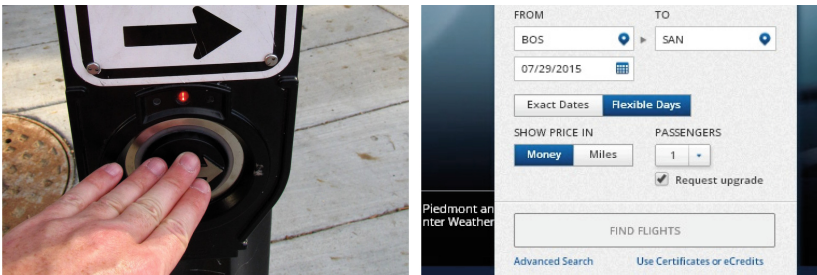
**Fig. 4.** Rome, Italy, 2013. A situational tactile map in center of the city as a conceptual model of the surroundings.

### E. Conceptual models

Even complicated devices can be understood better if we give the user a clear clue of how the device works. It is best if we can simply introduce a model which is then followed in the user's mind. The advantage is that we prevent making errors during actions. Let's now think of such models in our cities. They do exist: remember the tourist maps, topographical models or tactile situation maps cast in bronze (Fig. 4).

### F. Feedback and confirmation of an action

In most situations, multiple actions of the same kind immediately following each other are not the way we expect the user to behave. Thus, introducing feedback following an action keeps our users certain about their actions. If they believe in the system, they will wait – as long as they have a confirmation of their action (Fig. 5). There are light and sound signals in the real world, some of them we ignore as they are meant to be used by a special group of people (those who are blind, for example), some of them we do not want to understand because we are too busy reading the newspaper or talking on a cell phone. But they do “talk” to us and we interact with them every day.



**Fig. 5.** Feedback of an action as provided by a traffic light in Washington, DC (2010) – red light indicated that the required action was taken. Similarly, on Fig. 5, Delta Airlines website search (2015) indicates with a “blank” color that we just have pressed the “Find Flights” button. (Source Fig. 5: delta.com).

## 4 Smart Cities and Technodeterminism

Previous examples showed a few of many every day situations that we encounter in both, real world and the design of interfaces. It would be certainly interesting to conduct a research on how interaction designers perceive the cities they live in and how they approve or disapprove the interaction solutions in their physical spaces. Would they change or improve something? In fact, we should ask whether they do.

Progress of the mankind inevitably introduces new elements of everyday life into our environments. Let's perceive them as a whole new layer of information — or as new means of communication, advantages, sources of disturbance, and so on. At the same time, digital technologies and new media flood the markets, supposedly to achieve a marketing success and also to help people live their lives more efficiently and comfortably. In order to be as inclusive as possible, in further text we will be not

knowingly disqualifying those inhabitants-users of our cities who are not using personal digital devices, smartphones etc. In harmony with ideals of Jan Gehl [8], the professor of Urban Design program of the Royal Danish Academy of Arts, lets keep a presupposition that cities are here to encourage the idea of all people use (or even enjoy!) the environment, and communicate with each other within it.

With this in mind, one must ask what is the ideal model of our cities in the 21st century? If design can provide the perfect solution for any interaction of a user with their environment, are so called smart cities the ideal solution for the physical world we live in? How can interaction designers contribute for the life quality and what are the challenges that we face today, in the digital age? Is there still room for inexpensive and simple solutions in those smart cities, or are we too fascinated with technology driving us into the abyss of technodeterminism with a questionable functionality? (See Fig. 6) On the other hand, why is it that functional technologies whose positive effect was proven by years of usage, are sometimes disregarded? Driving experience in Vitoria, Spain is highly frustrating and finally leads drivers to totally ignore red traffic signals on the main road. Red lights there come off if no car is present on auxiliary roads, which makes the driving through this town a long and tiring ordeal.



**Fig. 6.** In 2014, Provincetown, Mass. introduced a solution that is aimed to improve the traffic flow in this popular resort town. Unfortunately, the operator of the largest municipal parking lot has to take a 10-minute walk in order to manually switch the signal indicating the actual situation in the parking lot. That is by switching the electric cord to another outlet.

Many elements of such smart cities are discrete and users hardly notice them at all: sensors in the road to help time the green light at the intersection, sensors in the escalators conserving energy by slowing the speed down when nobody uses the device or even

those simple motion sensors that open the door of the hotel for us. But one must ask crucial questions: Who is the designer? What does the term of smart city actually mean for different communities? Do the smart city elements fulfill the basic idea of design: to make the world more usable? There is hope that designer's intentions are not driven by monetary gains, producing redundant technologies. Yet, what if it is possible to argue that the adjective of "smart" may largely be a marketing construct that improves the perceived status of a city — various charts of smart cities exist out there [5], and hopefully they might lead our understanding of which characteristics the communities cherish as key for the "smartness" of a city. From the design perspective, a quest for grasping this understanding may be the most crucial value for future generations.

Designing wayfinding information in complex environments, to mention one example, may be extremely tricky given the structural qualities of the interiors. Dealing with the U-turn is one of the most difficult situations [14] and at Prague airport, there were three different attempts introduced in four years, until one effective solution was found. This reminds us clearly of words of Arthur and Passini [2]: "In planning the layout, [architects and urban planners] are creating the setting and the wayfinding problems future users will have to solve. In articulating the setting, they are providing the users with much of the necessary information to solve the wayfinding problems at hand." Here we have a viable note of design thinking. Arthur and Passini clearly argue that all problems cannot be only approached with placing a wayfinding sign. But we all know the world is not ideal, and having this in mind, we realize that new displaying techniques like the example at Paris CDG airport in Fig. 7 may help to find the way while respecting natural mapping and lowering the cognitive load of a passenger, who is always on the run in such places...



**Fig. 7.** Paris, France, 2013. A smart solution of a complicated wayfinding situation at Paris CDG Airport uses a projection on the floor immediately after stepping out of the escalators, combined with an animated arrow suggesting the direction of walk.

We should be interested to see where smart interaction design stands among these values and see through the ideology behind user interfaces, just as Lefebvre [11] discusses the ideology behind space relations in cities. Is the ideology we target in this design thinking actually corresponding with the usability principles – and how can we read the city as a system? De Waal [15] is asking even more crucial question: How does our interaction with new media actually change our relationship with cities? Answering this question may get even more complex when we consider the cultural background of our user/inhabitant/visitor: habits and cultural background in general may have effect greater than expected, as Brejcha [3] found out in his study on cross-cultural UX design. There is no reason to avoid this factor in the physical environments as well (see Fig. 8).



**Fig. 8.** London, UK, 2014. In London Subway, it is customary to walk on the left side, just as it is to drive a car on the surface. On the contrary – in Stockholm, Sweden, many subway elevators heading to the surface are positioned left, while the surface traffic keeps right. It may be the reminder of the fact that the surface traffic there was not changed to the right until 1967 [7], while the subway first opened already in 1950 [9].

## 5 Consequences of Design Thinking

We may ask what may possible be the advantages of thinking of these and other design principles in both, physical environments and interfaces. Innovation is always driven by such questions. The meaning of the world is largely based on representation and metaphors and new inspiration from situations in either place can always arise. New displaying technologies as well as completely new philosophical approach may find a



good use of revised use, as well as reinforcing of solutions already existing. Because – regardless the environment of interaction design – the main objective should always be introducing solutions that minimize the frustration of a user.

The connection between the physical world and interaction design practiced by interaction designers is inevitable. Inhabitants are users at the same time, and it is probably the right time for interaction designers to be employed by cities when hiring architects designing public spaces and buildings to avoid the above frustration in Vitoria just as one in Grand Rapids (Fig. 9).

In this situation, there is virtually no technology involved, and error could be so easily resolved. Systematic solutions involve tenets for to be followed by execution.



**Fig. 9.** Grand Rapids, MI, 2014. The communication situation that a driver experiences while approaching the bus terminal is rather puzzling and literally trapping.

Such manuals exist for the world of architecture or urban planning, but the author of this paper believes that cities would benefit from such tenets elaborated for the interaction as a separate discipline of public life. For interaction designers, this is a chance for a valuable input resulting in viable and enjoyable lives in our communities.

## 6 Future Work

In the future work, we tend to focus on a more precisely characterized urban interaction that would frame the area of the interest involving subtle use of technologies. From the interviews with city officials, it is obvious that the trend of city development focused on

smart technologies and interaction is very desirable in Prague, the city that the author of this paper calls home. Introduction of added city elements that would match the definition of interaction discussed above has been slow. The Institute of planning and development in Prague published a new Manual for design of public spaces [10] in 2014. It is a detailed file of tenets, but the interaction there is considered mainly as a physical or a social act, i.e., an interaction with city furnishing or among people. There is still some room left for the ambient or cognitive sense of interaction in the current version of this manual. Designing of complex information systems that would deal with design principles, design of information and semiotics of interaction are missing and thus seemingly not defined at all. We are aiming to research, provide and test such tenets with hope that they will be beneficial to inhabitants of a city as well as providing a positive “user experience” to the visitors.

Interaction tenets to be included in further work shall involve:

1. Investigating and defining values of “smartness” for smart cities, while disregarding the trendy-ness of such term, keeping in mind:
2. Principles for implementing discrete technology, and
3. Principles for implementing visible, audible and tactile technology in areas as, but not limited to: mobility and wayfinding, public services, enterprising, emergency services, education, and interaction devices in general.

## 7 Discussion

In this short text, we tried to illustrate that the principles of interaction design may be considered in the framework of modern cities. Metaphorically, we could speak of a “language” of the city which is used to communicate with its inhabitants. We believe that interaction design has the potential to be viewed as such a mean of communication. Covering the points drafted above may help us set a standard for evaluating the philosophical, anthropological, and sociological basics for cities of the 21st century. It is intriguing to view cities as interfaces or interaction systems which are seen through a prism of qualitative and quantitative research and thus available for user experience testing and evaluation.

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