

# Computer-Mediated Human-Architecture Interaction

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**Abstract.** One of the open questions in the concept of ambient intelligence regards user interfaces to these invisible computers. If at all, how do they show up – and how does ambient intelligence in general and the user interfaces in particular change architectural space. As computers become ubiquitous or ambient, they create spatial relations towards other devices and to the place that they are located in. This paper formulates chances and challenges for both architecture and HCI.

**Keywords:** Ambient Intelligence, Ubiquitous Computing, Smart Spaces, Aesthetics, Design, Architecture, HCI, Ambient Assisted Living

## 1 Introduction

A few decades ago, computers in domestic environments were stationary objects bound to a fixed location. Monitor, keyboard and mouse were set on a desk, which was more often located in workrooms than living spaces. The location of the computer desk within the room does naturally follow basic architectural rules, however the layout of the rooms that those desks are placed in does little to react the presence of the desk.

Quite the contrary is the case with television sets. As television became a center in the family live around the middle of the twentieth century [1], the living rooms mirrored this change. Furniture was designed to perfectly house all the components of the home entertainment systems. Until today, the layout of a living room often clearly shows that the television screen is the center of activities and thus the center of this space.

But compared to the history of television, the history of (domestic) computing is a short one. While homes might actually be slowly changing to accommodate the personal computer [2], there is a rapid trend that is contradicting this movement. Not only does the design of personal computers become more important [3] and set or reflect trends of a certain life style, but the miniaturization of computers made it possible to liberate from the more or less fixed location on the desktop and to become mobile – ubiquitous computing [4] became reality.

## 2 HCI and Space

In first world countries, people often own and carry around multiple mobile personal computers such as notebooks, tablet PCs and smartphones. But the access to computing power is not limited to those mobile devices [5]. Computers have begun to being integrated into our everyday environment [6, 7].

With the trend of ambient intelligence arising [8], a computer is no longer disconnected from any spatial relationship. Even if the user directly interacts with the mobile device at hand, the devices themselves become a part of a spatial network. The location of the device (and at the same time the location of the user) becomes tremendously important, with an ever growing demand for precision.

### 2.1 Location

A few years ago, the location of a computer was mainly relevant for the system time. It was thus sufficient to set any country within the same timezone as the actual position. With the emergence of mobile phones, country borders became more important as roaming contracts differ from country to country. Smartphones nowadays are often able to receive GPS signals and in combination with GSM localization which is possible with every mobile phone, the location of a smartphone is determinable with a precision down to around 10 meters. This enables to offer location based information on nearby points of interest as well as navigation and routing.

However, both GPS and localization via GSM becomes extremely unreliable or impossible when the devices move inside buildings. Also, the possible outdoor precision would not allow to distinct horizontally between rooms of a building, let alone the vertical distinction between floors.

The precise location is not only important for the device itself, but also necessary when integrating the device into a system of devices that relate to each other. The implicit situation and thus the way in that the user wants to interact with his environment differs depending on whether an interaction artifact is positioned on a table, held towards a screen, towards a lamp, placed on the floor, lying in bed or being carried around.

### 2.2 Urban Displays

Cinemas are not the sole domain for large displays anymore. As technology evolved, large screens gained presence in our every day urban landscape. While advertisement on large public displays is mainly dominant in large cities, urban screens nowadays regularly appear temporarily for public viewing of popular events.

On these occasions, the large screen for public viewing is the sole center of attention. The previous orientation of the place that was determined by adjacent buildings, landmarks or vegetation becomes obsolete. Basic planning rules regarding light, wind, circulation and emergency routes obviously have to be followed, but apart from that, the attraction of the displayed content should be

strong enough to create a successful happening.

While content is not an issue at those temporary events, simply because the content is the main reason for the event itself, the situation may be completely different for permanent displays. Those might evoke different or even negative reactions from neighbors or passers-by if the location is not carefully chosen using methods of urban planning, similar to the planning and analysis necessary prior to the creation of a new building [9].

This may be one of the first examples of architecture and digital media intermingling, but we argue that in the future this connection will get stronger and more complex and that the role of computers in urban environments will exceed the displaying function.

### 2.3 Domestic Displays

However, when, speaking about concepts like ambient intelligence, one of the key questions is regarding the materialization of it [10–12]. Is ambient intelligence entirely invisible, or does it visually integrate into our environment? Following the developments in display technology, enabling to build larger, thinner and more affordable screens, large displays might soon reach our domestic space. When those are no longer literally screens that are somehow placed in our living rooms, but when they become wall sized, they will inevitably become an architectural element. As such, the configuration of the rooms with such a wall sized display will change, because at least one wall will obtain new, previously impossible and unthought of properties. Speaking of architectural properties, a large display is a light source, allows for communication with outside spaces and (if touch enabled) lets inhabitants control the environment [13].

New possibilities arise with the – ubiquitous or ambient – integration of displays into our environment, however there are also new challenges. Precise location of the user within the room becomes necessary to display the content on areas that are visible for the user. Furthermore, the distance of the user towards the display changes the perceptible level of detail and requires flexible user interfaces [14]. Wall sized displays need to be seamlessly integrated into the room [15, 16]. Functions and situations need to be envisioned and planned prior to the integration of the display, similar to the architectural planning of a house.

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