

# Lost in Ambient Intelligence?

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## INTRODUCTION

In human-computer interaction (HCI) we recognize characteristics of human-human interaction. There is human-like behavior when interacting with the computer and human-like behavior of the computer is expected. Can we expect similar behavior when the user is interacting with an environment rather than with a desktop screen? In future environments computers are embedded in walls, furniture, clothes, and in objects that are natural in the environment. There is communication between these embedded computational devices allowing much more comprehensive knowledge of the environment and registration of events than is possible with a single computing device. Moreover, the knowledge and cooperation between devices is assumed to take care of social and intelligent support of the inhabitants of these environments.

These ambient intelligence environments are intimately integrated with our everyday environments. Ambient intelligence is said to consist of ubiquitous computing + social and intelligent user interfaces allowing social interaction. This also assumes that in ambient intelligence ‘the real world is the interface’. Garden, house, car, sitting room, study, office and in fact every environment and its natural objects allow perception of what is going on in the environment and allow interaction by its occupants and visitors to extract and exchange information (including mood and emotions). Nevertheless, we should feel comfortable within them, although we know that the environment has eyes and ears that observe what we are doing. We should also feel free and comfortable in addressing these environments when we need support in our activities. These environments will know about us. They know about our weak and strong points, they will induce affiliation needs and they will attempt to induce self-disclosure since they can perform better when they know about our intimate characteristics. We even have to assume that there is a ‘human audience’ in the ‘background’. There can be real-time involvement by those who own the environment or have been hired to provide user-support. Off-line processing (manual browsing of what has been going on

or automatic detection and presentation of what is in the interest of those who control the environment) is another example of audience involvement. In a home environment, we may assume that family members and friends can obtain access to such browsing facilities.

## INTERFACING IN AMBIENT INTELLIGENCE

Most of the current research in ambient intelligence deals with how the environment is able to identify and model users’ activities, rather than how the user is willing, able, or likes to communicate with the environment or have the environment communicate with him [1]. In more traditional environments multimodality in interactions has received attention, but it has hardly been investigated how these results can be transferred to environments where the user does not always explicitly address a particular (part of a) screen or an object. Moreover, most of the research in ambient intelligence does not take into account that people may feel lost in ambient intelligence, may not know who to ‘talk’ to and may not be able to build some kind of relationship with the anonymous environment that nevertheless supports them, observes them and keeps track of their activities.

What kind of relationships do we have with our traditional interfaces? There is already a trend towards designing social interfaces, emphasizing human-to-human communication properties, rather than concentrating purely on designing intelligence and efficiency. In this research, the computer is perceived as a social actor. Interaction should be socially formed and interaction design should take into account needs of emotions, personality, affiliation, friendship or even more. Much of this research is related to the design of embodied agents. An obvious question is, will embodied conversational agents that are able to develop affiliative relationships [4] with their human partners play an important role in ambient intelligence environments?

Just to help our intuition about the direction of future research, look at remarks made by Michael Coen from MIT Labs about the effects of smart environments on their inhabitants: “The notion of being alone may disappear, or it may be changed drastically.” And, “You may be in a room that’s always alive and aware. And from my experiences here...when the space is ‘off,’ you feel it. You notice that it’s not reacting. There’s a void.”

## THE ENVIRONMENT AS AN ACTOR?

We need to identify the role of an environment. Is there a need to introduce explicitly accessible agents (social actors) or can we develop some kind of relationship with an envi-

ronment like we are able to build a relationship with a computer that is perceived as a social actor or with an embodied agent made visible on a screen, wall, table, or some other kind of object, maybe following us from environment to environment? A starting point for research in these issues is the “Media Equation” [3], where the authors report about experiments on humans assigning human characteristics to computers. It became known as the “social reactions to communication technology” perspective in which “computers are social actors”. Made clear by experiments, it is not only a matter of contributing personality characteristics to computers; it is also a matter of being influenced by these properties while communicating. The book’s conclusion? *“Our strategy for learning about media was to go to the social science section of the library, find theories and experiments about human-human interaction - and then borrow. We did the same for information about how people respond to the natural environment, borrowing freely. Take out a pen, cross out “human” or “environment,” and substitute media. When we did this, all of the predictions and experiments led to the media equation: People’s responses to media are fundamental social and natural.”*

Remarkably, looking at the experiments underlying the research presented in this book and looking at the experiments designed after the publication of this book, the so-called ‘natural environment’ does not really play a role in the observations in the book and the experiments that were designed. That is, rather than to rely on these authors’ observations, we have to look at the interaction characteristics of human-environment interaction and design our own research. We should mention that it is not unusual to contribute personality characteristics to a room, a house, a mall, a street or square, to a town or even to a landscape or another natural environment. On the one hand, one may think that thoughts and activities (i.e., interactions with the environment) are influenced by the particular environment, on the other hand, users or inhabitants may choose a particular environment, may adapt the environment to their preferences and, whatever they do, leave their traces and because of that, their personalities in these environments. There are links between individuals and the physical environments they occupy [1]. Similarly, we may assume that whenever technology allows, consciously and unconsciously, links are created between individuals and their (ambient intelligence) environments.

### RESEARCH QUESTIONS

For interface designers several questions arise. First of all, are there aspects of human-human interaction we do not want to lose because they allow or are necessary for social, private, efficient and entertaining human-environment interaction? Having identified these aspects, do we want or can we induce them when we design interaction between humans and environments? Which research questions have to be answered when we want to investigate social interaction, which research questions are there when considering private interactions, which research questions are there to consider when talking about efficient interaction, and which

questions have to be answered when looking at problems or opportunities for entertaining interactions in ambient intelligence environments? More detailed questions can be asked, taking multi-disciplinary and mono-disciplinary viewpoints. To illustrate how diverse the problems are, we give three examples.

- Designing human characteristics in the environment is an issue. Research on social psychology may help us to introduce characteristics that support the development of social relationships between inhabitants and environment.
- Fusion and fission of information is an issue. Models are needed that allow not only recognition, but also interpretation of what is going on in a smart environment, using information obtained from different information channels. Multi-party interaction modeling is needed, where objects, physical inhabitants, virtual inhabitants and (future) observers can all play roles in the multi-party interaction.
- Trust relationships between human and environment and privacy awareness are issues. Do we need a distinction between private cyberspace and social cyberspace? If so, what kind of technology is needed to realize this?

### GOAL OF THE WORKSHOP

This workshop aims to:

- Identify HCI problems related to interacting in ambient intelligence environments;
- Discuss problems related to the fusion and fission of information in ambient intelligence environments;
- Provide a forum to discuss the role of social psychology in ambient intelligence interaction;
- To discuss a research agenda, including the identification of relevant ambient interaction theories and relevant applications.

We hope to attract researchers from a wide range of disciplines, including HCI, Computer Science, Artificial Intelligence, Psychology and Social Science.

### REFERENCES

1. S.D. Gosling et al. A room with a cue: Personality judgments based on offices and bedrooms. *J. of Personality and Social Psychology* 82 (2002), No. 3, 379-398.
2. A. Nijholt. Multimodal Interactions in ambient intelligence. In: *Algorithms in Ambient Intelligence*. Philips Research Book Series, Kluwer. W. Verhaegh, J. Korst & E. Aarts (eds.), 2003.
3. B. Reeves & C. Nass. *The Media Equation: how people treat computers, televisions and new media like real people and places*. Cambridge University Press, 1996.
4. T. Takahashi et al. Change in human behaviors based on affiliation needs. 4th Conf. on *Knowledge-Based Intelligent Engineering Systems & Allied Technologies*, R.J. Howlett & L.C. Jain (eds.), Vol. 1, 2000, 64-67.