

Mental vs. Physical Disappearance: The Challenge of Interacting with Disappearing Computers

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ABSTRACT

In this paper, I describe the challenges designers and developers of “user-interfaces” will face in the context of creating smart artefacts where the computer as a device will be in the background, will be “invisible”. I will start out by distinguishing between “mental” and “physical” disappearance and discuss a number of resulting design issues and affordances. I will especially address smart building environments with multiple devices that provide situated services based on context-aware applications. Examples are taken from previous work and from our recently launched project “Ambient Agoras: Dynamic Information Clouds in a Hybrid World” that is funded by the European Union as part of its “Disappearing Computer” initiative.

Keywords

Mental disappearance, physical disappearance, calm technology, smart artefacts, affordances, coherent experiences, ubiquitous computing, situated services, context-aware applications

INTRODUCTION

There are many points of departure or perspectives one has to address in order to discuss all the user-interface issues raised by the organizers of this workshop. I will name some and have to restrict myself further when talking about examples. There is: 1) the human and subjective experience perspective, 2) the functionality perspective, 3) the technology perspective, 4) the generic tool vs. application perspective, 5) the individual vs. group activity perspective, 6) the social experience and situational context perspective, 7) the virtual information space vs. real physical, architectural environment perspective, and so on. In order to make progress in this field, one has to combine them into a compound view. One direction of doing this, is to adopt Mark Weiser’s [4] position who stated: “The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.” And I like to add “... and facilitate a coherent and social experience when interacting and

cooperating within the environment by providing appropriate affordances.” We take this view and interpret it as the design goal of a two-way augmentation and smooth transition between real and virtual worlds. Combining real and virtual worlds in a computer-augmented environment resulting in hybrid worlds allows us to design enabling “interfaces” that build on the *affordances* of everyday reality and virtuality seeking to use the best aspects of both worlds. I will give some examples later on.

Our approach is to transform and transcend human-computer interaction resulting in rather direct *human-information* interaction and *human-human cooperation* based on *human-artefact* interaction, at the same time making the technology device character of computers disappear.

THE DISAPPEARING COMPUTER

In our approach, we are initially distinguishing two types of disappearance of computer devices but then we combine the different types in our actual design.

- *physical disappearance* of computer devices is achieved by making the computer-based parts very small so that they can fit in the hand, be interwoven with clothing, be attached to the body or even implanted in the body. In most cases, the computer is integrated in a “shell” of a compound artefact of small dimensions where the features usually associated with a computer are not visible anymore.
- *mental disappearance* (and I will distinguish further between *cognitive* and *emotional* disappearance) of computers is achieved by becoming “invisible” to the “mental eyes” of the users. This can, for example, happen when computer devices are stripped of their usual casing and are embedded in the architectural environment (e.g., walls, doors) or furniture (e.g., tables, desks, chairs) around us, somehow appearing in a new camouflage. The important aspect here is that they are not perceived as computer devices anymore but as embedded elements of augmented artefacts in

the environment. Examples are the roomware components we developed [2, 3].

I distinguish between “cognitive” and “emotional” disappearance in the following way. In the *cognitive disappearance* case, the appearance of the devices is transformed so that they are not perceived as computers anymore but as information appliances for communicative and cooperative situations. The resulting artefacts can be even quite large, as in the example of an interactive wall (our DynaWall measures 4.4 m wide and 1.1 m high) or an interactive table with a horizontal surface (e.g., our InteracTable) although it is smaller than the wall but still larger than a standard desktop computer display. People perceive more visual stimuli and associations that remind them of available everyday objects than of computer displays and boxes. In these cases, people move the „computer device“ character in the background and the functionality in the foreground.

In the *emotional disappearance* case, users are “drawn in” by a high emotional load of the artefact. Take the example of a stone-like artefact (similar to a “Handschmeichler” in German) with a very smooth surface and a round or oval shape that fits the shape of the palm of your hand very nicely. You like to touch and move it in your hand, to play with it, to carry it around in your pocket, etc. Another example would be a game with a very intriguing functionality and easy to handle interaction that guarantees full control over the game. It provides so much fun and excitement that after some time you even forget about the standard desktop display you are using as an output device. In this case, the functionality available, e.g., via a very realistic animation is important for creating this type of disappearance. The notion of functionality brings us to the next point.

AFFORDANCES FOR DISAPPEARANCE AND COHERENT EXPERIENCES

Causing computers to disappear is not really our final goal and not only because you might wonder about the answer to the question “how do I interact with an invisible computer?” I like to argue that the notion of disappearance is an important objective on the way to achieve the goal of what we call “coherent experiences” in human-information interaction and human-human cooperation. This becomes obvious when we realize that the visual appearance of the integrated artefact is only one aspect of making computers disappear. It is one design dimension of the affordances of disappearance. The other very important dimension is the type of interaction available. Useful disappearance and finally coherent experience is the result of the combination of macro affordances (physical shape and form factor) and certain micro affordances (e.g., tactile characteristics of the artefact’s surface) in combination with the software providing appropriate interaction affordances. In many cases, their design is based on metaphors taken from real

world objects and actions in order to be intuitive and thus minimizing the learning effort.

EXAMPLES

The affordances of the Roomware® Components DynaWall® and InteracTable®

The DynaWall® developed at GMD-IPSI and part of the i-LAND environment [2] in the AMBIENTE-Lab is a large interactive wall covering one side of the room completely. The size of 4.50 m (15 ') width and 1.10 m (3' 7") height and the very smooth integration of this very large display (realized by a back projection which is hidden to the user) into the architectural structure creates the impression that you are really writing and interacting with a wall or wallpaper, depending on which metaphor is conveyed, resp. people adopt for themselves. The surface is touch-sensitive so that you can write and interact on it with your bare fingers or with a normal pen (no electronics needed). Several people can write/ interact in parallel in (currently three) different areas of the DynaWall. Beyond these physical affordances, our BEACH software enables very intuitive interaction based on gestures that are reflecting actions with physical objects in the real world (e.g., “take and put”, “throw”, “shuffle” , ...). When throwing objects (with different accelerations), the speed and thus the flying distance is dependent on the initial momentum provided by the user. People can interact this way immediately after having seen it once.

Similar combination of affordances are provided by the InteracTable®, another roomware component we developed. It has a display size of 65 cm x 115 cm and a diameter of 130 cm (50 "). Beyond the type of interactions available at the DynaWall, it provides additional forms of interaction required by horizontal and round or oval-shaped displays. To this end, we developed in BEACH special gestures for shuffling and rotating individual information objects or groups of objects across the surface so that they orient themselves automatically. This accommodates easy viewing from all perspectives. Furthermore, one can create a second view of an object, shuffle this to the other side so that the opposite team member has the correct view at the same time. Now, everybody can view the same object with the correct perspective in parallel, edit and annotate it.

It is important to note that although the physical appearance of a wall and a table is different the visual appearance of the information objects and the design of interacting with them is providing a coherent experience. Other examples are the ConnecTables® where moving them together in physical space results in creating a shared workspace between them in the virtual world. More details for interacting with different roomware components are given in [3].

The affordances of the Passage mechanism

Passage is a mechanism for establishing relations between physical objects and virtual information structures, thus

bridging the border between the real world and the digital, virtual world. So-called *Passengers* (Passage-Objects) enable people to have quick and direct access to a large amount of information and to "carry them around" from one location to another via physical representatives that are acting as physical "bookmarks" into the virtual world. It is no longer necessary to open windows, browse hierarchies of folders, worry about mounted drives, etc. Passage is a concept for ephemeral binding of content to an object. It provides an intuitive way for the "transportation" of information between roomware components, e.g., between offices or to and from meeting rooms.

A Passenger does not have to be a special physical object. Any uniquely detectable physical object may become a Passenger. Since the information structures are not stored on the Passenger itself but only linked to it, people can turn any object into a Passenger: a watch, a ring, a pen, glasses, a wooden block, or other arbitrary objects. The only restriction Passengers have is that they can be identified by the *Bridge* and that they are unique. Passengers are placed on so-called *Bridges*, making their virtual counter parts accessible. With simple gestures the digital information can be assigned to or retrieved from the passenger via the virtual part of the Bridge. The Bridges are integrated in the environment to guarantee ubiquitous and intuitive access to data and information at every location in a building (=> cooperative building). For example, a Bridge can be integrated into the table top of an interactive electronic table (=> InteracTable[®]) in the cafeteria or mounted in front of an interactive electronic wall (=> DynaWall[®]) in a meeting room. More details can be found in [1].

We think that the preceding examples provide first steps of moving away from human-computer interaction and via human-artefact interaction towards human-information interaction and human-human cooperation. But we have also to be aware of the fact that this approach will be only one (important) part of the story. It remains to be seen if taking only metaphors from the real world is the best way to design disappearing computers. Similar to the breakdown of the "desktop" metaphor based on icons for folders and trash cans showing us the limitations of that approach, we will witness that a unidimensional approach will cause a lot of problems again.

This was a major motivation for us to extend the scope of the problem space and place more emphasis than before on more comprehensive architectural environments, collections of artefacts and a wide range of activity patterns when interacting with those artefacts and moving in these spaces.

ARCHITECTURAL SPACES AS INTERFACES FOR COHERENT EXPERIENCES

In January 2001, we started the project "Ambient Agoras: Dynamic Information Clouds in a Hybrid World" (www.Ambient-Agoras.org). It is funded by the European Union as part of its proactive initiative "The Disappearing Computer". The project "Ambient Agoras" aims at

providing situated services, place-relevant information, and feeling of the place ('genius loci') to the users, so that they feel at home in the office, by using information technology (IT) in an innovative way, e.g., mobile and embedded in the environment. "Ambient Agoras" adds a layer of information-based services to the place, enabling the user to communicate for help, guidance, work, or fun. It integrates information into architecture through smart artefacts, and will especially focus on providing the environment with memory, which will be accessible to users. The computer as a device will disappear, but the functionality will be available in a ubiquitous, and invisible fashion. Finally, "Ambient Agoras" will augment reality by providing better "affordances" to existing places. It aims turning every place into a social marketplace (= agora) of ideas and information - an *Information Market Place* - where one can interact and cooperate with people.

As the title implies "Ambient Agoras" is a project that brings together technology and people in a particular context. The context and metaphor we will pursue is that of the "*Greek Agora*", a place in the center of economic and social activity where information and ideas are exchanged. In Ambient Agoras, this center of activity is not a particular location in the building but is ubiquitous and distributed through the artefacts that we will augment and use - everyday objects, variations of furniture and architectural elements - which are interconnected and aware of the actions and activities in the environment. While the specific activities are still under discussion, we will focus on the creation, capture and spread of information. We want to support the recollection and accessibility of events, actions, and information products that are created in selected social interactions.

At the workshop in April, I will also report on our design ideas for the smart artefacts we will develop in order to realize the "Information Clouds" for Ambient Agoras. If the organizers are interested, I can also frame this with a report on the goals, research directions, and projects of the European "Disappearing Computer" (DC) initiative being the chair of the recently elected Steering Group of all DC-projects. More information on the initiative can be found at the website which is currently being built up: www.disappearing-computer.net

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