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From pictogram to sensogram

- wayfinding through pervasive computing and multisensory perception

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Within the latest decades, geographical and navigational information has formed the basis for the design discipline of wayfinding. Until now, this field has mainly been characterized by a visual approach through static, two-dimensional signs, symbols and typography on signposts, walls and buildings in the urban space. With the advances in computer technology and the rising complexity of available embedded information in public places, a new approach to wayfinding and navigation is emerging where the traditional static and visual wayfinding is supplemented or replaced by multisensory and digital communication. This paper coins a new term: sensogram and outlines how technology and theories about the body allow a multisensory and intuitive approach to wayfinding. By means of pervasive computing, the pictogram used in wayfinding is transformed from analogue to digital, from visual to multisensory and from signposts to the physical space. The sensogram suggests a new holistic approach to the body and to human perception in architectural space, which seems absent in both traditional pictograms and contemporary wayfinding. We analyze this approach from a multisensory perspective. Through a discussion of the former visual dominance within the field of pictograms in wayfinding, this paper considers how the two-dimensional and visual phenomenon can be rethought and redesigned by incorporating established design knowledge and pervasive computing in architectural space. In closing, two design experiments are used as the basis for discussing what further research the experiments enable within the context of pervasive wayfinding and the design of atmosphere or ambience.

Keywords

Graphic design, interactivity, mediation, pictogram, sensogram, wayfinding, pervasive computing.

Background

As a graphic discipline, wayfinding begins to take shape in the early 20th century, as visual pictograms are introduced as a means of offering directions in modern industrialist cities and built environments. In 1960, the discipline of producing signs with the purpose of providing directions in an urban planning context is termed “way-finding” (Lynch 1960: 4, McCullough 2004: 33). As a practice field this discipline is aimed primarily at producing two-dimensional indicators for use in signs, on walls and in

buildings. According to Kevin Lynch (1960), wayfinding refers both to the human capacity for spatial localization based on sensory impressions and memory and to the interpretation of information in anything from maps to charts and pictograms with the purpose of wayfinding.

In a research context visual signs, including pictograms, have been the object of interest since the early 20th century, for example in semiotics. Within the field of semiotics, the study of pictograms, ideograms (signs or symbols that indicate a concept or idea) and logograms (signs or symbols indicating a word), classified together as ideography¹, was established as a new field with an emphasis on classifications and conceptual definitions within the visual field and on the conditions for meaning construction in the decoding of visual signs (see e.g. Aicher-Scholl 1994; Barthes 1964; Kj rup 2004; Mollerup 1995).

In a practice context, pictograms have developed mainly in a context of modernism and framed by an essential positivist paradigm that maintains universalist strategies for the communication of visual signs (Lupton 1989). One of the models is Otto Neurath's Isotype system from the late 1920s, whose simplifying and functionalist approach goes some way toward setting a norm for modern pictogram design that still seems to serve as a convention today, based on requirements for a simplified expression and an ideal of the universal and supreme status of visual representation. A tradition that, according to Ellen Lupton, to some extent has hampered the incorporation of insights from semiotics and cognition research concerning the role of context and culture in the visual construction of meaning (Lupton 1989; 1993). Modern pictogram design continues to be based on the Functionalist tradition and an objective of reducing communicative content. Furthermore, pictograms continue to develop as an exclusively graphic discipline within the domain of visual perception. This is borne out, for example, by the design theorist Per Mollerup's breakdown of wayfinding into three activities: search, decision and motion (Mollerup 2005: 27). Search is executed by means of vision, decision is executed in the mental domain, and motion is executed by the body. A key element in this definition is the visual sign, the pictogram, which in the wayfinding situation is realized cognitively as meaning, before the body executes the mental decision, so to speak.

In recent years, however, advances in information technology have opened new perspectives for the design and perceptual scope of pictograms. According to Peter Morville (2005) these developments offer new opportunities for expanding on the visual domain that has characterized wayfinding until now: "*After eons of stumbling around the planet, we're about to take navigation to a whole new level. Wayfinding 2.0,*" (Morville 2005: 71). While classic visual pictograms are characterized by establishing a static relationship between a person and his or her location in space, technology allows for a

¹ Ideography is text consisting of images or conceptual signs without any pictorial associations to the thing they signify. Although pictograms are usually in the form of simplified images, in a semiotic sense they are not images, because they do not resemble the things they signify. Instead, they are symbols, conventional signs (Kj rup 2002: 69).

more dynamic and multisensory relationship, where information about places, rooms and destinations is made available in new ways and through multiple types of sensory input. This is relevant both in relation to mobile units, where pictograms serve as a tool for showing the way or locating site-specific information via a computer interface, and in relation to wayfinding in the urban space and architectural environments, where pictograms can perform in entirely new ways. In the present context, the focus will be on the role of the pictogram as a means of wayfinding in architectural space, supported by pervasive computing. The paper will argue that pervasive computing both signifies a new practice field for the graphic designer and enables other, experimentally oriented approaches to a pictogram design that not only requires mental, cognitive decoding, like the classic two-dimensional pictogram, but also engages the body as an active part of perception.

Pervasive computing as a design material

Pervasive or ubiquitous computing combines physical environments and devices with the computerized reality of interactive systems. The media theorist Stefan Poslad (2009) defines pervasive computing as ubiquitous information and technology systems “*that enable information and tasks to be made available everywhere, and to support intuitive human usage, appearing invisible to the user*” (p. 2). Pervasive computing is also used as a broader category capturing combinations of digital, virtual and physical environments that are addressed by practice and research disciplines such as Collaborative Virtual Environments, Augmented Realities, Augmented Virtualities, Tangible Bits (see e.g. Ramsgaard 2004; Ishi 2008).

In relation to wayfinding, developments in digital technology have led to discussions about which paradigms for technology support the field of wayfinding should rely on in the development of new concepts for wayfinding and wayshowing. In the interface industry and in HCI and usability studies, the development of user interfaces for both physical and digital interfaces aims to give the users a sense of direct and unmediated access to information and functions. This ideal is reflected, for example, in Mark Weiser’s (1988) and Donald Norman’s (1999) original visions of “*The invisible computer*” and in the design strategies in the interface industry of achieving ‘direct’ and ‘intuitive’ manipulation. The latter is reflected, for example, in user interface standards such as WYSIWYG (What You See Is What You Get), which describes a situation where an additional layer of visualization gives users visual access to the state of programs and data. Thus, the mediation offered by the interface makes it appear as if the user were manipulating the data directly, while in fact the person is operating through several layers of visual mediation. The notion of the invisible interface is reflected in the industry’s verbal and visual rhetoric with terms such as transparency and direct access. It is also evident in new research and development areas such as pervasive computing, where function and efficiency constitute the ideals of technological mediation (Ranganathan et al. 2005; Henriksen & Indulska 2006; Stefan Poslad 2009; Genco & Sorce 2010).

From an artistic and experimental perspective, however, wayfinding that relies on

pervasive computing is not restricted to serving functional purposes alone; it may also form the basis of new and more experimental concepts and designs. In the context of experimental design, for example, the design researcher Anthony Dunne advocates a more visible presentation of computer technology which users can address critically and thus develop more satisfying relationships with. Dunne talks about a certain estrangement or alienation effect, which in contrast to user friendliness engages in a direct dialogue with the user (Dunne 2005: 35). In a similar vein, computer scientist Poul Dourish points out that technology must step more into the foreground in interaction contexts, becoming present as a visible component that engages the user: “... you cannot be engaged with something that essentially isn't there. Invisibility is not engaging; invisibility does not communicate,” (Dourish 2004: 202). According to Dourish, the challenge in relation to future technologies lies in developing concepts that materialize, produce meaning and offer possibilities in use-related and spatial contexts.

The design researchers Vallgård and Redström (2007) suggest that pervasive computing can be made visible and engage users in new ways by entering into combination with other materials. They suggest that pervasive computing should be considered a material in its own right, which has no specific “properties” and thus depends on other materials in order to become the object of a design process. They define pervasive computing as a “composite material” that must be incorporated into other materials to become useful in design practice and visible to the user (Vallgård & Redström 2007: 2).

The use of pervasive computing in architectural space not only defines a new material but also creates new possible forms of wayshowing that do not necessarily have function and efficiency as their primary goals. From an emotional perspective, wayfinding is not always about achieving the most efficient navigation. Users do not necessarily navigate in a rational and logical manner – especially not ‘repeat users’. With pervasive computing taking care of the memory task, the users can feel safe and ready to take on new experiences by walking through a building, finding their way, meeting others – or getting lost. Due to its flexible and variable nature, technology is capable of delivering efficient wayfinding in case of emergency as well as creating new performative and aesthetic interfaces as a form of expanded and experience-based architecture.

In a practice context, the expanded scope of wayfinding makes it necessary to consider the user in a different light; the user now becomes part of the wayfinding situation and an active co-creator of its realization as wayshowing. In wayfinding that is based on pervasive computing, the information is not only available to a stationary gaze as visual points but also forms an underlying network of systems that defines a path of accessible information directed at several of the user's senses.

The body as an active part of wayfinding

The expanded perceptual scope not only involves a concern for the development and positioning of visual representations but also requires an explicit concern for the ability of the body and the body's movements in space to create various forms of meaning. In the

wayfinding situation, the body has a real-time experience of triggering information by means of motion in space, for example by amplifying a sound or activating a visual or tactile output with motion, touch or gestures (Passini 2002: 24). Here it is up to the designer to enable the various multisensory expressions and interactions and to enable the user to be present and empowered in the computerized space.

In a theoretical sense, the technological involvement of multiple senses sets new parameters for the understanding of wayfinding as a field that is associated with a mediated state and where the distinctions between computer-mediated and unmediated perception are blurred. The mediated experiences intervene in and become an inextricable part of the user's 'natural' experiences in a wayfinding situation by entering into combination with the user's concrete experiences of the physical environment. Therefore the designer must explicitly address how the mediated experiences and their intervention into the physical world affect the user's experience of his or her body and its relations with the world. This is a far-reaching discussion that involves questions of a psychological, sociological and philosophical nature. Within the field of pervasive computing these considerations have led to discussions about the essential nature of a 'body' and about how the body is perceived and created by means of technology (see e.g. Hayles 1999; Wood 2002; Dourish 2004). In this context, there is particular interest in the phenomenological tradition, which also forms the basis of many studies within the field of HCI, where it enables an understanding of the relationship between human cognition and objects and surroundings (see e.g. Winograd and Flores 1986 and, for more recent practice-based, normative studies of user experiences, e.g. Garrett 2002; Goodwin 2010). When technological memory is embedded in space, the discussion of the relationship between body and objects expands to include not only the interaction with computers and digital artefacts but also people's sense of being and presence in a room. With pervasive computing, the body, in a sense, becomes the user interface, as it is the body that moves, acts and interacts with the computerized space. In the wayfinding situation the space and the path are generated throughout multiple rooms and environments by the user's extended being and actions.

Sensogram: a multisensory approach to wayfinding

There are already examples of the use of pervasive computing in wayfinding, although the field is still in its early stages, and most of the examples are experimental. One of the areas that have worked most extensively with the use of pervasive computing in wayfinding is R&D for people who are blind (inclusive design) (e.g. Manduchi 2008; Knapp 2009) and location based systems and wayfinding in airports (e.g. Hansen et al. 2009).

The present paper presents an experiment with the use of pervasive computing in a building; the experiment aimed to remediate a familiar, historical pictogram in a digital context via a multimodal representation design that involved bodily perception. The concept, which consisted of two experiments, was based on the assumption that the pictogram as a graphic discipline also makes sense in a pervasive wayfinding context,

where it may serve to support existing conventions. We refer to the multimodal pictogram as a *sensogram* with reference to its multisensory mode, which requires an involvement of the body; this is in contrast to traditional two-dimensional pictograms, which have a visual representation form and rely mainly on ‘mental decoding’.

Sensogram #1

The pictogram symbolizing a public toilet is probably the most common pictogram in the world. It was chosen here for its natural relationship with the body and its conventional historical status, and the attempt is made here to transfer it to a digital context. The interactive pictogram was designed with the real-time programming environment *Max/MSP* and installed in March 2008 in the Kolding School of Design in Denmark and the goal was to remediate a familiar pictogram by establishing it in a digitally supported wayfinding situation: showing and finding the way to a toilet and



Experiments with Sensogram #1 in March 2008. Photographer: Mette Harrestrup Lauritzen.

experimenting with its various expression and interaction forms in a spatial environment at a hotspot in the building, where many people pass by several times a day.

In its realization, Sensogram #1 interacted via sound images of running water and animations of the toilet pictogram, where two figures in the pictogram were swaying and bending. In a sense, the experiment used pervasive computing as a ‘material’ that was made visible by means of sounds and animated images displayed on the white-painted walls of a passage area. The sound and animation were generated solely by passers-by as they were captured by a camera and motion detection system. The more motion was recorded in the room, the more animated the toilet pictogram became, and the louder and faster the sound of dripping, trickling, running water. The sounds were mixed and programmed to provide soft, blended transitions between the various water sounds. The goal was to give passers-by a sense of animating the visual pictogram and of turning the water flow up or down via body motion. When an increased level of motion was detected, the dripping rate increased, and the sound of running water gradually blended in from the background to blend with the dripping, which in turn was gradually toned out. When there was no activity, the animation and the faint dripping sounds gradually faded out. The purpose of the sensogram was to address the phenomenological body

directly by giving passers-by an instinctive urge to urinate triggered by the sound of running water.

As part of the experiment a user study was carried out that involved observations of users of the building for a period of nine hours, during which time around 400 people passed by at least twice. While the sensogram was in place, studies found that most of the passers-by stopped for a few seconds the first time they passed by and began to interact with the digital pictogram in order to figure out the concept. Others spent more time exploring the possibilities. Almost all the people who stopped were able to decode the interaction concept immediately: that by moving their bodies in space they would increase the sound level, animate the visual output and increase water volume.

Unlike a tactile or mobile interface, where form, colour and interaction remain constant, the sensogram provided the illusion that output/feedback via sound or video projection was dynamic in character. The passers-by 'played' the sensogram as if it were a musical instrument. The ones who stopped made attempts at increasing sound and animation by using their arms, which they all intuitively began to wave in front of the sensogram. Others who spent more time interacting with the sensogram also included the use of other limbs, moved their entire body, raised a leg or nodded their head. In the experiment the body influenced the formation of meaning in real time by activating sound images or triggering the visual output of the sensogram as the person moved through space or in front of the sensogram.

The observations of the sensogram supported the notion that the users would be offered a wider range of perceptual opportunities, as the sensogram stimulated additional senses and involved the body and thus made the user's experience of the computerized passage area coincide with his or her experience of the physical space. On a small scale, the experience with Sensogram #1 demonstrated that meaningful interaction can be established across the boundary between computerized and physical space. The user interface of Sensogram #1, which involved the bodies of the passers-by, relied both on the persons' experience with the physical environment and on a classic pictogram design, but it also indicated new forms of interaction between technology and human users. While the traditional user interface incorporates and extends the user's actions by means of a tool – for example a mouse or a mobile display, which users have to learn to use before they can perceive their actions as actions – Sensogram #1 attempted to expand familiar actions and turn them into actions that could be used to manipulate and enter into dialogue with the interface.

In the experiment with Sensogram #2, the intention was to build on the experiences from the first sensogram and present the mediated information in the same familiar surroundings. Only, in this case the sensogram would be programmed to switch between a visible and an invisible state. In addition, the experiment set out to test more sensual forms of value creation in space in connection with the user's interaction with the sensogram.

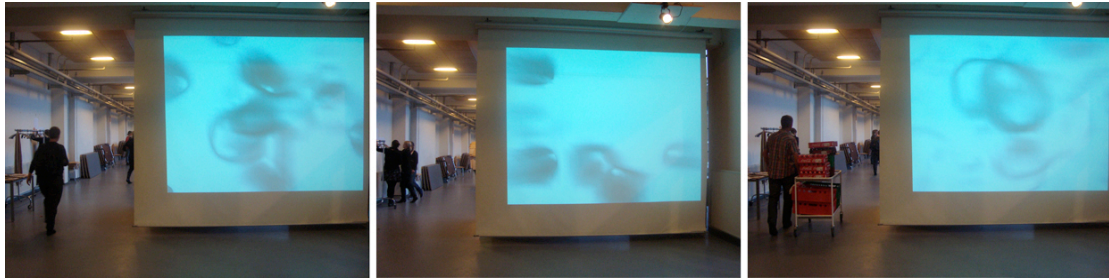


Experiments with Sensogram #2 in December 2009. Programming the sensogram with Max/MSP resulted in animations of the public TOILET pictogram and a digital illusion of water, waves and authentic sounds from restrooms. Photographer: Mette Harrestrup Lauritzen.

Sensogram #2

The experiment with Sensogram #2 was carried out the following year, in December 2009. In this case too, pervasive computing was used as a material that was realized by means of other materials – in this case the walls of the room, light reflections and sound images. For this purpose, two different ambiances or atmospheres were created by means of the sensogram, and technology was used to generate shifts in atmosphere and scene in the room. The two opposite concepts that were addressed in the experiment were inspired by, on the one hand, a classic attempt at generating a sense of harmony, which played deliberately on traditional conventions of beauty and natural sounds, and, on the other hand, Anthony Dunne’s concept of *user-unfriendliness*, which encourages a critical and reflective dialogue with the user. The ‘test atmospheres’ were labelled, respectively, “the beautiful atmosphere” and “the private atmosphere”. Unlike Sensogram #1, where the interaction only resulted in animations of the familiar toilet pictogram and a harmonious sound image, Sensogram #2 stepped closer to the users and their private and intimate boundaries in order to test some of the limits and means of interaction.

“The beautiful atmosphere” used what might, from a conventional point of view, be called a harmony-seeking and aestheticizing approach based on connotations with ‘nature sounds’. The visual output consisted of organic, undulating movements in a digital water surface combined with the sound of trickling water. The goal of this was to



Experiments with “the beautiful atmosphere”. Photographer: Mette Harrestrup Lauritzen.

evoke a sense harmony and spark associations to nature experiences. This experiment found that passers-by were unlikely to react, even though the room was filled with sound; this was perhaps because many were already familiar with the experiment, which meant that the visual elements and the sounds were perceived as less obtrusive. Or perhaps it was because the sounds were less engaging, as they drew on conventional sound and associations to what we normally perceive as background music – muzak – as in an elevator or a supermarket.

In contrast to “the beautiful atmosphere”, “the private atmosphere” featured intimate and private toilet sounds and thus represented a form of communication that breached the conventional boundaries of the physical and social space. There were the sounds of footfall, of doors being locked and of urine splashing in the toilet pan combined with humming. When the camera recorded maximum motion in front of the sensogram, the sound of a flushing toilet was triggered. The experiment was carried out on the same terms as the first experiment with a nine-hour observation of passers-by and included approximately the same number of passers-by.

As in the Sensogram #1 experiment, “the private atmosphere” experiment monitored passers-by and found that about fifty percent stopped to try out the interactive possibilities. In comparison with the first sensogram, the average passer-by spent more time on the experiment, and many responded with surprise, laughter or smiling. Some even seemed embarrassed or appeared to find the situation silly or disgusting. In comparison with “the beautiful atmosphere”, the user-unfriendliness approach appeared to evoke stronger feelings and a higher degree of engagement. With its transgression of personal boundaries by means of unexpected sound features, the pictogram was more obtrusive and tended to involve the users more.

In comparison with a static and two-dimensional graphic pictogram that mainly ‘appears’ to passers-by if they are searching for a toilet, the digital toilet sensogram was characterized by attracting attention and to disrupt the flow as the passer-by moved from one location to another. The pictogram offered a situational interaction that was shaped by the degree to which the passer-by related to the sensogram and the interaction possibilities it offered.

In these experiments, the focus was shifted from the style and functional characteristics of the pictogram to considerations of the possibility of designing interactive sensograms to engage, affect and enter into dialogue with the user. The site of the experiment seemed open to change, and the passers-by were affected by the

experiments. Passers-by appeared to have been particularly emotionally affected and disarmed when their personal boundaries were challenged in the public space. The experience of passers-by was that they could control the communicative changes in the scene with their bodies, and in that sense the sensogram connected the classic visual pictogram with a more multisensory approach to pervasive wayfinding.

These experiments and the related reflections on the historical and contemporary role of the pictogram facilitate an exploration of the graphic designer's traditional area of activity and the conventions for pictogram design in wayfinding contexts. By including pervasive computing these experiments have indicated new possibilities for designers involved in developing wayfinding and wayshowing concepts.

Conclusion

In the present paper we have focused on the role of the pictogram in wayfinding and described its historical status and design norms. We have also described how the pictogram can incorporate pervasive computing and thus be activated and realized in new solutions that remediate the traditional pictogram in a technologically supported wayfinding context. In the paper, the concept of the sensogram is proposed as a new discipline with a multimodal scope, whose decoding involves more specific senses than the conventional pictogram. The sensogram is demonstrated in two experiments involving a classic wayfinding pictogram for a public toilet and its realization in a spatial architectural context.

In connection with the experiments the paper reflects on the shift from the analogue, visual pictogram to the interactive and multisensory sensogram. It also highlights how pervasive computing in a wayfinding context may serve as a new material for designers that can be combined with other materials in connection with the development of new wayfinding concepts.

Furthermore, the paper suggests how the use of pervasive computing in wayfinding challenges the functional paradigm that is assumed to have defined the traditional graphic discipline of wayfinding, and which also to a large extent underlies the ideals of transparency and direct mediation in user interfaces that characterize the interface industry. Through an experimental approach to the use of pervasive computing in wayfinding the paper demonstrates that it is possible to highlight the experiential dimensions of the interaction and to contribute to an expansion of architectural space by means of alternative forms of technological ubiquity.

The paper points out that wayfinding that involves pervasive computing calls for new theoretical understandings of the role and scope of the body as it interacts with expanded or information-charged rooms that are characterized by gradual transitions between the virtual and physical dimensions, and where the spatial experience is a result of the individual user's presence and 'co-creation' of digital experiences.

In contrast to the traditional graphic pictogram the interactive sensogram requires an embodied user interface where the interaction is an event that is anchored in an embodied experience of presence in a room.

The paper proposes that the sensogram may serve as the basis for additional experiments with wayfinding in architectural contexts or as a conceptual basis for wayfinding in online digital information architecture or in multimodal pictogram design for mobile phones.

In the sensogram experiments the focus was on the objective of transferring the classic pictogram to a technologically supported wayfinding context, while the user studies were only a secondary concern. In any future developments of the sensogram, it would be relevant to involve more user studies as well as studies of expanded forms of interaction and aesthetic user experiences. This might shed light on how people experience and react to digital and interactive stimulus in public spaces like airports, hospitals, museums and urban environments. In a practice context, it is still important for wayfinding to maintain a functional intention of providing clear, accurate and effective information in connection with warnings and instructions, for example, but it is the claim of the present paper that it is equally essential to engage in experimental approaches to wayfinding and wayshowing in order to continually shift the boundaries for our use of technology and design in providing sensual communication in cities and architectural space. Pervasive computing constitutes a new material for the graphic designer and enables experimental wayfinding concepts that challenge the traditional functional paradigm in favour of new ways of producing pictograms and interacting in space. This gives designers and architects an opportunity to begin to design sites (not just rooms) and experiences (not just information).

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