

Enabling the Emergence of New Everyday Aesthetic Practices with Ubiquitous Computing

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ABSTRACT

New enabling technologies and their design into particular artefacts or applications have a decisive impact on emergent aesthetic practices. Each technological revolution implies a shift in thinking and in design approach. With ubiquitous computing, a step can be taken from confining digital aesthetic practices in pre-designed interaction spaces, to embedding them into the everyday physical world, a place not designed for the specific purpose of such practices that imposes new requirements on design: a leap in design approach needs to be taken. The PhD thesis described in this article attempts to find out what the nature of this leap is and what it requires to take it.

Keywords

ubiquitous computing, aesthetic practices, design leap, everyday creativity, real-world interactions, pervasive and locative media, interaction design, physically integrated interaction.

1. INTRODUCTION

1.1 Emergence and Evolution of Aesthetic Practices with New Technologies

Along with socio-cultural and economical factors, technological progress is a strong driving force behind the evolution of the arts and other aesthetic practices, enabling the emergence of new forms of expression [25].

Throughout the history of photography for example, technical innovations have affected the way we take and look at pictures, from the invention of the flashlight to that of colour emulsions, from the advent of the portable cameras to that of disposable ones, and from the development of digital cameras to their integration into mobile phones.

The same applies to music, where a cascade of technological innovations have enabled the design of new instruments (whether built from scratch or based on existing ones), which in their turn have enabled new forms musical expression: the invention of the phonograph opened the possibility to reproduce recorded sounds; electricity to amplify instruments as in the electric guitar; analogue electronics, first in the forms of vacuum tubes then of integrated circuits, gave birth respectively to the first electronic music instruments and to the first synthesisers; with digital computing, the multi-purpose computer became a tool for music making that is now used in the largest part of contemporary popular and academic music; finally, a spectrum of alternative music instruments and controllers developed in unison as well as in parallel with the evolution of interactive technologies, are pushing the boundaries of what playing a music instrument is.

1.2 Design Leaps Implied by New Technologies

Specific aspects of the design of technological tools can impact on emerging artistic practices and forms of personal expression; whether the use of the technology is as intended or takes unexpected forms. Even in the case of turntables, a classic example of musical use that was not intended nor predicted by its inventors, the cyclic and reproductive qualities of the device were intrinsic parts of the emergent practice of turntablism [11].

Designers of emerging technologies have therefore an important role to play in the enabling of future aesthetic practices. And each technological revolution implies new premises, new opportunities and new challenges for designers as well as practitioners: each time, there is a leap to take, a shift of thought to make in how we apprehend medium, technology and practice, in order to fully embrace the possibilities lying ahead. Therefore, there is a need to reflect on how to design applications that enable their users to take full advantage of the opportunities that emerging technologies carry, in terms of enabling aesthetic practices.

1.3 Enabling New Aesthetic Practices with Ubiquitous Computing

In my research, I am interested in the leap from aesthetic practices enabled by regular digital computing to those enabled by more ubiquitous type of computing that would embed them in the everyday: what is the nature of this leap, what does it require to design for it, and what happens when you take that step? This present article summarises my PhD thesis, which attempts to provide some answers to these questions.

2. MOTIVATION AND RELEVANCE OF RESEARCH

Ubiquitous computing distinguishes itself from other types of digital computing by the ambition to move away from desktop settings and make computing available at hand in the real world, where needed, where the action is [26, 7]. Computing should become invisible in use and disappear into the fabric of everyday life, the same way any other mature technology do. What can make computing disappear and make it available where needed is its literal integration into the real physical and social world.

The main potential and challenge of ubicomp is thus that it allows to take the step from confining activities in pre-designed interaction spaces (whether it be desktop environments, designed physical artefacts, or designed interactive spaces) to embedding them into the real world, the everyday physical world: a place not designed for the purpose of these new activities, therefore

requiring from systems that they adapted to its topology and dynamics.

While this statement might sound trivial when considering the body of work surrounding the development of context-aware computing, its application to the enabling of new aesthetic practices is far from trivial. Beside the fact that the real world already exists and cannot easily be modified to accommodate emerging practices and interactions, challenges facing a designer attempting to take this leap are that physical and social environments are heterogeneous, dynamic, and to a certain extent unpredictable, while aesthetic practices often imply a subtle balance of control with improvisation. Designing with these requisites is thus delicate work. Moreover, one should be careful to avoid falling into the trap of just transposing previous types of digital interactions onto this new setting.

At the same time, these features as well as the physical nature of the real everyday world make it rich of various and engaging interaction opportunities - an advantage in terms of creativity. It offers many new opportunities that were not possible with digital art: mobility through urban space can become a geographically extended musical gesture with the urban environment as interface, photography can capture more of a context than meets the eye and use invisible factors as new control parameters... With this genre of practices situated in the everyday, the real world becomes more than a setting for interaction, it becomes a resource for it, where the physical properties of everyday environments and artefacts can be used to mediate interaction and create new meaning.

Practitioners within the field pervasive and locative media [21] - a general denomination for projects exploring the possibilities of new media with an awareness of place, location and context (e.g. [8]) - are already appropriating ubiquitous computing technologies for creative purposes [22]. This thesis is intended as an input to the development of this field. It might also be of interest for designers facing the challenges of future technological leaps, and of their impact on the enabling of new aesthetic practices.

3. THEORETICAL FRAMEWORK

Dealing with the design of ubiquitous computing technologies for everyday aesthetic practices positions the thesis at the intersection of different disciplines, requiring perspectives from each of them. A theoretical framework for the thesis should therefore encompass theories from disciplines as various as of ubiquitous computing, human-computer interaction, cultural theories, and art theory.

From the fields of human-computer interaction and ubiquitous computing, a concept central to the thesis is that of embodied interaction [7], a model for interaction with computing systems resulting from the combination of tangible computing and social computing. The concept of embodied interaction is based on the phenomenological notion of embodiment: people making sense of the world through their situated experience of and interaction with it. Designing with the notion of embodied interaction in mind consists of recognising the fact that people create and manipulate meaning through their interactions with the world, and in our case with computing systems. Various authors (e.g. [12, 24]) have also emphasised the role of 'place' and 'context' (where we act instead) in framing interaction and argued for a focus on these notions, as opposed to space and location (where we are just being located). These theories give an interesting perspective to the design of new

technologies situated in place and time in the real everyday world, and to the relation between interaction, creativity, and meaning.

The notion of everyday life has mostly been approached within the field of cultural theory. Cultural theorists have been investigating the nature and essence of the everyday by studying how people make an everyday for themselves, what makes the fabric of it, and what inhabits it. Of particular interest is de Certeau et al. and their theory of the practices of everyday life [5], consisting of studies and reflections on procedures of everyday creativity, and of descriptions of people's poetic ways of making do (use of language, cooking, etc). The use of these theories in my thesis is motivated by a need to understand what the everyday actually means, in order to be able to use it as a resource for interaction. Particular theories such as de Certeau's everyday tactics and strategies are also used as theoretical background to the analysis of my research material.

The role of art theory in this thesis is dual. First, notions of contextual [1] and site-specific art [17] help shed a light on the nature of situated aesthetic practices. Second, analysis of the impact of reproduction techniques and digital technology on the arts written by respectively Benjamin [3] and Manovich [19] are used as points of comparison: because the emergence of these two technologies also implied leaps that needed to be taken, drawing a parallel to them in taking the ubicomp leap helps inform the process.

Still unclear however, is how to make this multidisciplinary set of theoretical references into one unified theoretical framework.

4. METHODOLOGY

The research work that this thesis is based on consists of a series of experimental projects exploring different aspects of the research topic, as well as workshops. Within the projects, concepts are explored and developed during design processes, and embodied in prototypes. The prototypes are then tested during user studies, and design implications drawn from the results of the process. Project teams have multi-disciplinary backgrounds and vary for each project.

This methodology is intended to cover the following aspects of my research question: what possibilities do ubiquitous computing carry that were not possible with other technologies, how do you design for it, what kind of behaviours and practices emerge from the use of these technologies, and how the various aspects of the design shape these practices to a certain extent.

4.1 Concepts and Design Process

Concepts on which the projects are based are meant to illustrate opportunities for aesthetic practices and physical interactions integrated in the everyday that were not previously possible with non-ubicomp digital computing. The types of media they experiment with are mainly sound and still images.

Design processes use methods from the field of interaction design: structured brainstorming, sketching, scenarios, probes, focused workshops with extreme users [13], etc. Focus is kept on interaction on an individual level and with a first person's perspective, rather than on form or computational performance.

In terms of supporting aesthetic expression, the design process is also influenced by methods used in the development of alternative music controllers within the HCI-oriented field of NIME (New Interfaces for Musical Expression) [20]. For example, mapping

strategies commonly used in the design of musical controllers [15] were extended to mappings of sensor input to visual aspects of still images in the Context Photography project (see paragraph 5.2.1).

4.2 Prototyping

The role of the prototypes is to exemplify, test and refine design ideas as well as embody research questions [14], working as open-ended platforms for iterative development and real-world testings with users. The prototypes are either built from existing prototyping platforms, from scratch, or from hackings of consumer electronic products. Most are functioning prototypes incorporating properties of ubiquitous computing systems such as context-awareness, networking capabilities, or physically integrated interaction procedures. However, the various aspects that would make for a complete ubiquitous computing system are only implemented up to a certain resolution, in order to enable rapid iteration while still enabling real-time interaction in real-world user studies: it is not a system as a whole that is evaluated during these testings, but its properties and characteristics when put into use.

4.3 User Studies

My research follows the Scandinavian research tradition of new informatics as defined by Dahlbom [6]: a design-oriented study of information technology in use, with the humanistic ambition to change things (technology use as well as society). This school of thoughts considers that designing information systems without studying how people use them is insufficient, as people appropriate technology through use and do not necessarily behave as expected. In our case, unexpected creative behaviours are even desirable. Therefore, prototypes are tested in real world settings by a variety of everyday people with different backgrounds. Users are told how the technology functions but not what exactly they should do with it in order to avoid influencing their use. Data generated by the studies are analysed with a focus on qualitative results such as user experience, rather than on questions of computational performance, for example.

4.4 Workshops

Besides these projects, the research process includes the organisation of workshops about one particular field of pervasive and locative media: mobile music technology [23]. The goal of these workshops is to identify issues within the field and push it forward, as a collaborative effort among practitioners, designers and researchers.

5. PROJECTS

When exploring the design leap to ubicomp-enabled aesthetic practices and determining what it requires to take it, I look specifically at:

- What kind of new aesthetic practices can be enabled by this technology, when approaching the everyday physical world as a resource for interaction;
- What happens with existing types of digital media and creative practices when one adds a dimension of ubiquitous computing to their tools, and thereby blends the media with the everyday physical world;
- How physically integrated types of interactions between user and media influence the emergence of new practices.

In the process of my research, I have been working on the following projects, which can be grouped into the themes mobile music, new photography, and bricolage.

5.1 Mobile Music

Mobile music is a new media relying on the use of mobile computing. This media is characterised by a tension between place and music creation, listening or sharing. This tension is created by its mobile nature and results from the fact that mobile music devices can be used anywhere but at the same time have an awareness of place. When becoming mobile, the media is displaced from a particular location to the movements of a particular user, providing a soundtrack to her life as the Sony Walkman™ once did [4], but with additional properties such as networking capabilities (enabling music sharing with strangers in public space [2]), or context-awareness (enabling certain forms of mobile music making, as the paragraph 5.1.2 will describe).

5.1.1 Mobile Music Technology Workshops



Figure 1: Mobile Music Technology workshops

I have been actively involved in two international workshops on mobile music technology, the first one as invited speaker and the second one as co-organiser [23]. The workshops gathered an exciting mix of researchers, designers, musicians, new media artists, and representatives of the industry. The aim of the workshops was to discuss the directions of mobile music technology as well as establish a community around the field. In the first workshop, we reviewed and discussed the state-of-the-art, and determined opportunities and challenges for mobile music (Figure 1). The second one focused on getting a deeper understanding of the design issues surrounding mobile music and how they differ from stationary music practices. Each workshop consisted of presentations followed by discussions and structured brainstorming sessions. A third workshop will be held in 2006, which I am also co-organising.

5.1.2 Mobile Music Making: Sonic City

In this project, we wished to explore the notion of mobility as musical gesture: walking through shifting urban contexts, turning the city into a musical interface and paths into musical compositions.

We designed, implemented and evaluated a wearable prototype that turned the city into an interface for real time electronic music making. It enabled its user to create a personal soundscape of live electronic music by walking through and interacting with urban environments. The prototype consisted of a small laptop computer, a microphone, headphones, a microcontroller, a MIDI interface, and a number of sensors. It gathered information about the user's actions and surrounding context with sensors worn on the body and a layer of context and action recognition. This data controlled the audio processing of live urban sounds collected by



Figure 2: Sonic City

the microphone. Resulting music was output through headphones in real time and in the context in which it was created, as the user was walking [9].

The use of Sonic City was a personal experience intimately linked to that of everyday urban settings, as the music was a direct result of one's interactions with the city and was heard in context (Figure 2). A user study [10] showed how when engaging with this type of situated aesthetic practice, users would alternate from immersive rediscovery of everyday urban space; to background music listening to the dynamic musical soundscape while managing other mobile factors such as traffic and social contexts; and active engagement into the music creation by looking for interesting context to be in and local interactions to engage into in an ad hoc way.

5.2 New Photography

The project Picture This! aims to depart from a digital photography just mimicking the analogue one in terms of capturing pictures, and explore new potentials for picture taking, visual representation and picture-sharing with the help of ubicomp technology.

5.2.1 Context Photography



Figure 3: Context Photography

Context photography consists of capturing more than incoming light in an image, i.e. the *context*. Information about the physical context gathered from various sensors visually affects pictures in real time, as they are taken. Translating non-visual data into visual effects in an image modifies the relation between input and output in the camera. Where previously a camera would only sense light and fix it as a still image in a way that could be considered as objective (because only depending on the laws of physics), this

interpretation adds a new dimension of subjectivity. We wished to determine the implications of such modifications of the digital camera on how it is conceived and used. Another question was how to interpret the context data visually without annihilating the user's sense of personal expression.

After a first prototype implemented on a Tablet PC [18], our context camera prototype is now ported to standard camera phones. The earlier version was used during evaluation workshops with lomographers and teenage amateur photographers (Figure 3), and in design exhibitions. The camera phone version has been used in college courses about site-specific art and digital photography. This particular prototype also allows us to conduct a large-scale user study by letting users simply download the software to their own camera phone.

Some typical user behaviours when using the camera are to look for sources of input such as loud environments, or to explicitly create such input themselves by e.g. producing noises by screaming: users take advantage of available resources at hand from the environment and from themselves. Preliminary results prompt on the importance of effort in personal expression, and of matching characteristics of the visual translation of sensor input to the perception that the users have of their surrounding context.

As a next step in this project, we are conducting a large-scale user study during a period of one month in order study the evolution of the use of the camera in the long-term.

5.2.2 BashoCam

BashoCam is a newly started project exploring the notions of networked narratives with still images, and rhythm in photography. As the project is still in an early stage of development, its description will be succinct: a group of pictures captured by a user within a short rhythmical time-line is sent as an animated loop of still images to other users in her social network. During a limited timeframe, the other users can add their own pictures to the loop by adjusting the timing of capture to the existing visual rhythm in order to complete it, thus creating a joint visual narrative distributed over their social network. The application is intended to combine the sharing of moments between friends at different locations with the collaborative aspect of networked performance.

The design and implementation of this project is on-going and should be concluded by a user study, hopefully during fall 2005.

5.3 Bricolage & Physically Integrated Interactions

In each of the previously described projects, aspects of everyday life are repurposed with ubiquitous computing, for the aesthetic practices of making music, photographing or collaboratively building visual narratives. Immediate surroundings and user actions become resources for the user to be creative with on the spot, while the technology in itself serves as entry points to these resources. What are the possible forms and particularities of interactions for this type of computational repurposing, how do they influence the emergence of aesthetic practices and how can they be shaped to enrich experiences? These questions are tackled in the previous projects, but also further developed in design experiments where we sketch simple examples of aesthetically and physically integrated interactions in the everyday. These

interactions are based on the physical properties of existing everyday environments (affordances and constraints).

5.3.1 Tejp: Embodied and Situated Interaction with Locative Media



Figure 4: Tejp audio tags

In Tejp [16], we experimented with poetic means of creating and accessing location-based personal layers in public space, either by adding layers or revealing existing ones.

In these particular design experiments, we aimed for context-specific and expressive communication: conveying meaning with the use of a large bandwidth medium (sound) and with expressive types of gestures and physical interaction subtly embedded into physical and social contexts. We voluntarily avoided the use of PDAs. An example of such design is the audio tags. Audio tags are small devices that would be left on urban structures (e.g. walls) and whisper audio messages to by-passers getting closer to them, opening an ephemeral space of intimacy in public space (Figure 4). With this mini-prototype, the physical space mediated the interaction between the user and the information layers by letting the media be accessed in the real world through the embodied gesture of ear-whispering.

Simple yet effective designs of this kind were done based on a study of new forms of graffiti and street art that we had conducted in the beginning of the thesis work. In this study, we repeatedly found examples of discrete uses of surrounding context and ephemeral situations into street art pieces, for example underlining street lamp shadows that only appear at night [27], or using chalk to draw pieces that later get washed away by the rain. This led to the model of parasitic interaction [16], where elements of physical environment are re-used as an intrinsic part of a computing system functionality. This model was later on further developed and extended in the project Bricolage (a work-in-progress).

6. DISCUSSION

Open questions remaining in the thesis are the following:

- Are there other theories within the discipline of Ubicomp that I should use?
- How do I make my multidisciplinary set of theoretical references into one unified and appropriate theoretical framework?
- What perspective should I take in the analysis of the projects results and how should I position them in order to make a relevant and useful contribution to the research topic and the field of ubicomp in general?

7. CONCLUSION AND FUTURE WORK

I have presented the current state of my PhD thesis, which attempts to find out what it takes to take the leap from designing

for new aesthetic practices with digital computing to ubiquitous computing. Future work includes finishing up the research projects and drawing final conclusions based on their results.

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